THE INTERNATIONAL SUGAR JOURNAL.

A TECHNICAL AND COMMERCIAL PERIODICAL DEVOTED ENTIRELY TO THE SUGAR INDUSTRY.

JANUARY TO DECEMBER,

1927.

VOLUME XXIX.

LONDON:
ST. DUNSTAN'S HILL, E.C. 3.
1927.

CONTENTS FOR JANUARY, 1927.

Managing Editor - - - - - NORMAN RODGER.

Technical Editor - - JAMES P. OGILVIE, F.I.C., F.C.S.

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ANNUAL SUBSCRIPTION, 21s., Post Free.

SINGLE COPIES, 1s. 9d.; 2s. Post Free.

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CONTENTS FOR FEBRUARY, 1927.

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CONTENTS FOR MARCH, 1927.

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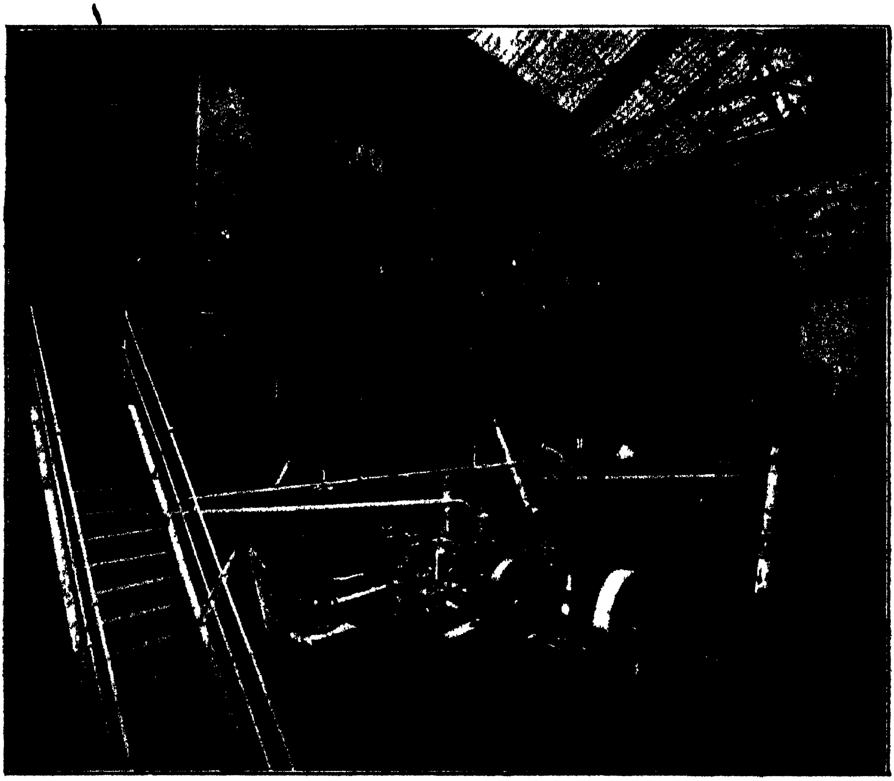

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For **INDEX TO ADVERTISERS,** see pages lvi.—lix.

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For **INDEX TO ADVERTISERS,** see pages lvi.—lix.

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For **INDEX TO ADVERTISERS,** see pages l.—liii.

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For **INDEX TO ADVERTISERS**, see pages lii.—lv.

The Journal is published about the 15th of the Month.

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Technical Editor - - JAMES P. OGILVIE, F.I.C., F.C.S.

For **INDEX TO ADVERTISERS**, see pages lii.—lv.

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INTERNATIONAL SUGAR JOURNAL.

☞ All communications to be addressed to "The International Sugar Journal," 2, St. Dunstan's Hill, London, E.C. 3.

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable . but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

No. 337. JANUARY. 1927. VOL. XXIX.

Notes and Comments.

The Cuban Crop Restriction.

The Cuban crop restriction decree was signed by President MACHADO on December 10th, and the doubts which remained in some quarters as to whether he would finally take that step were thus laid to rest.

In accordance with the law of May 3rd, 1926, which authorized him to fix the exact date at which the sugar mills were to commence work for the 1926-27 season, and also to declare the exact amount of the reduction to be effected in the crop, he confirmed his earlier decrees of last September that work at the crushing mills should not commence before January 1st, 1927, and declared that after careful investigation he had arrived at the firm and irrevocable conclusion that the limitation of the said crop to four-and-half million long tons would be of great benefit for all interests connected with the Cuban sugar industry, as well as for the general welfare of the island. He also decreed that the reduction to be made by each mill shall be based on estimates made by the Secretary of Agriculture, Commerce and Labour, who is authorized to enforce the decrees and maintain the strict application of the penalties established against infraction of the law. In accordance with this decree, all cane left in the fields after the mills have ground their allotment will have to be held over for the 1927-28 crop. And there is said to be enough cane growing this season to produce six million tons of sugar !

Opinions in sugar circles are by no means unanimous as to the wisdom of the step taken by the President. There are some who look on it as a short-sighted policy which will damage Cuba's domination of the sugar markets of the world, just when the goal is supposed to be in sight. Other nations, they argue, will now take heart, and endeavour by larger production to push Cuba into the back-ground. But the fact remains that even Cuba could not afford to go on producing sugar at a price which brought in a profit to only a fraction of her producers, and being such a large producer herself she has a better chance of success than have any lesser lights in taking the step of calling a halt in the present process of over-production. It may be observed

that the analogy of the rubber industry does not seem to us irrelevant as an example of what can be done by even partial voluntary reduction of output to improve the economic side of production. When a few years ago the price of rubber was entirely unremunerative and most small producers were threatened with bankruptcy, the Stevenson scheme of curtailment of crops in all rubber territories within the British sphere of influence was successfully launched and has entirely justified its trial, as all the world now knows. Yet when it was first mooted it was argued by the critics that the scheme, being only partial inasmuch as it did not bring into the agreements the Dutch and other large foreign rubber producers, would only result in giving the market to the latter at the expense of the British producer. Events have worked out differently, and all rubber producers have benefited by the voluntary restriction of one large section. One must hope that the step Cuba has taken will likewise benefit all, not least her own, sugar producers.

Actually, the immediate effect of the Presidential decree has been, as *Facts about Sugar* points out, to advance the price of sugar to an extent which, if not any further exceeded, will give Cuba on her restricted crop of 4½ million tons a remuneration of fifty million dollars above the amount that would have been realized from an unrestricted crop of five million tons at the former price. And yet the full importance of the Cuban restriction has not as yet been fully reflected on the sugar market, but may be expected to raise prices further in the near future. There is talk in Cuba of 4-cent sugar, but it is more generally agreed that a maximum of 3½ cents would be more desirable, since a higher price might cause undue optimism and lead to excessive speculation, an eventuality not to be encouraged if the sugar market is to keep stabilized round a price yielding a fair profit.

The Incidence of the Raw Sugar Duty in Japan.

The Japan Sugar Trade Review calls attention in a detailed editorial to the way the Customs duty at present levied on foreign raws imported into Japan militates against the success of Cuban sugar as compared with Java muscovado, as imported by the Japanese refiners. This duty is refunded in case of the export of refined sugar made from imported raws ranging between Nos. 11 and 15 D.S. But Cuban sugar is apparently not offered in so convenient a form to the Japanese market, since Cuba either exports "second class raw sugar in colour" and compels the buyers to pay a high rate of customs duty, or else exports sugar after some admixture with molasses in order to lower the colour standard and so clear the customs more cheaply, in which event trouble and expense are added to the work of refining such sugar. When in addition to these facts deliveries from Java are as a rule much quicker than from more distant sources like Cuba, it is not to be wondered that Japanese refiners are indisposed to take other than Java muscovados when they have in view the preparation of a refined for export markets like China. Java sugar as a consequence is in demand in the East even at a price above the world's parity; but this ascendancy may also be ascribed in part to India's periodic dependence on Java for sugar, whenever her own crops fail to meet requirements.

Whatever the precise causes, this comparative command of the Far-Eastern markets by Java sugar producers is not looked on with favour in Japan; and for some time past Japanese refiners have made repeated attempts to alter the situation by getting their Government to revise the existing system of Customs duty and export drawbacks. This, we gather, the Japanese Government are now disposed to do. They are studying a new duty regula-

tion covering all foreign raws, and the refiners are asking them to extend the range of duty on raws up to Head-sugars or No. 21 D.S. If this alteration is effected, it would result in the Japanese market being freely open to Cuban sugars, which might come in to any extent up to half-a-million tons. The present demand for foreign raws in Japan is put at about that amount, but the trade expect ere long to increase their sales in China sufficiently to warrant an import of raws amounting to anything up to 700,000 tons. If only half this amount of sugar were taken from Cuba, the latter's position in the Far-Eastern markets would be a very appreciable one.

Our contemporary points out that even if this invasion of Japan by foreign raws becomes an accomplished fact, it would not damage the business in Formosan sugar in Japan, because Formosan Head-sugar is in secure and steady demand in that country on account of its long-established attractiveness—its brown colour and large size of grain. This sugar has for long commanded a sale in Japan to the extent of 3½ million piculs annually, and can compete effectively even at a higher price with Java sugars. The entry, therefore, of Cuban sugar into the Japanese raw sugar market would be at the expense of Java, not of Japan's colonial sugar. But if Cuba is to compete successfully, it will be necessary for her to make a special study of the Far-Eastern requirements and send out there the class of sugar that is needed, instead of dumping her excess production regardless of its precise quality. One thing is clear, and that is that Japan is no longer content to buy raw sugar from adjacent territories, but desires to be free to obtain her supplies from any world source that seems advantageous.

The College of Tropical Agriculture, Trinidad.

The report of the Principal of the Imperial College of Tropical Agriculture in Trinidad for the year 1925-26, which has just lately been published, contains a full summary of the work undertaken during the year.

It is noteworthy that the field from which students are drawn is widening, there having been in residence during 1925-26 four students from the Union of South Africa, one from Brazil, one from Egypt, and one from Ecuador. Similarly, it is noted that already students who have passed through the College are employed in the Union of South Africa, Southern Rhodesia, Uganda, Nigeria, the Gold Coast, the Sudan, Ceylon, Barbados, Trinidad, Antigua, and British Guiana.

The staff under Dr. MARTIN LEAKE has undergone no increase, but there have been a number of changes owing to members accepting posts in other spheres of work. Since Professor BOYD resigned the chair of Sugar Technology in 1925 there has been no appointment of a successor, in the absence of a suitable man being available; but Mr. W. SCOTT, B.Sc., technologist of the Usine St. Madeleine, has filled the position temporarily. During this year the sugar factory did not operate, but the delay has afforded the authorities time to work out a well considered scheme for the Technology Department. Meantime the students taking the course have spent the crop season at the St. Madeleine factory. Actual field investigation has been limited by the available area, but has been directed to obtaining more intimate knowledge of the parental characters of the cane hitherto growing in that area. And the frog-hopper investigations are being carried out by a committee working in conjunction with the College.

This Report also contains the prospectus for the 1927-28 course of study.[1] We notice that the approximate expenses of a three-year course

[1] This can be obtained on application from the London Office of the College at 14, Trinity Square, London, E.C. 3.

of instruction, assuming the student stays in Trinidad the whole period, work out at about £265 for the first year, £280 for the second, and £242 for the third year, plus, of course, the return passage to and from home. This includes living expenses, which are obviously subject to the personal element. There are also the students nominated by their countries who can come in under reduced fees; and students from foreign countries can be accepted at double fees, or £100 per annum.

Retirement of Dr. Schack-Sommer.

Dr. GUSTAF SCHACK-SOMMER, the well known chemical engineer and sugar refiner has lately retired from business life owing to ill-health. He has been engaged for nearly half a century, first in Liverpool and afterwards in London, as a sugar refiner, and has been on the board of Martineaus, Ltd., for many years, having been in fact the Chairman since that Company's foundation in 1896. Dr. SCHACK-SOMMER may be considered one of the pioneers in sugar beet experiments in this country, he having carried on investigation work in that branch of agriculture as far back as the eighties of last century. His work in this line is to be found in the *Journal of the Society of Chemical Industry* from 1889 to 1895, and the pages of our predecessor, the *Sugar Cane*, also bear witness to his work. For instance in 1890 and 1891 we reproduced[1] papers of his on "Home-grown Sugar in Great Britain and Ireland"; and in 1895 gave a tabulation of "Six Years' Experiments in growing Sugar Beet in this Country."[2] We trust that the relaxation afforded by cessation from active work may restore to him such a measure of good health as will allow him to enjoy his days of retirement.

Beet Sugar in Scotland.

The beet sugar industry in Scotland has not made such rapid progress as might have been expected (says the *Glasgow Herald*). The Greenock factory converted from a raw sugar refinery commenced operations in 1925, and in 1926 the Cupar factory, operated by the Anglo-Scottish group, commenced slicing on November 8th, and was officially opened by Lady GILMOUR, wife of the Secretary of State for Scotland, on December 11th.

The Cupar factory is the first complete beet sugar factory built in Scotland, and is the sixth in Great Britain built by Messrs. Duncan Stewart & Co. It is erected on the left bank of the river Eden about half-a-mile east of Cupar, Fife, with convenient access both to railway and to road for the reception of beet and other material and the despatch of products. Operations at the site commenced in February, and the factory has been in running order since the first of November. It has been a technical success from commencing work, and now requires only more support from the farmers in the supply of beet to make its success complete. The site has an area of 46 acres, of which the buildings cover two acres, the remainder being used for railway sidings, roads, beet storage silos, and settling ponds for water. There are three and a quarter miles of railway sidings and one mile of roads within the site. The beet delivered either by rail or road is received into the silos, which cover 1½ acres, and are able to contain 10,000 tons of beet, equivalent to about 20 days' supply for the factory at its present capacity. Area is reserved for extending the silos as soon as the probable supply of beet warrants this.

It has now been proved that beets can be grown in Scotland, and that the average sugar content of the roots supplied to Cupar is considerably higher

[1] *Sugar Cane*, 1890, 189-196; 1891, 241-252. [2] *Sugar Cane*, 1895, 145, 157-8.

than that on the Continent, where it has been cultivated extensively for nearly 100 years. Thus to make beet sugar a complete success in Scotland there is only required more careful cultivation to increase the yield per acre, and more farmers to grow this crop.

Position of the Brazilian Sugar Industry.

According to the Monthly Review of the Bank of London and South America, Brazilian sugar growers have been passing through a difficult period for some time past, and in common with other industries they have had to surmount some vital problems. At the outbreak of the war the total production of Brazilian sugar was about 150,000 tons per annum, thence it was rapidly increased to 812,000 tons, but by last season it had declined to 650,000 tons. Between 1921 and 1923 producers were obliged to adjust their activities to the diminishing value of the milreis, which had the direct effect of increasing the cost of living, and so advancing the price of labour. A subsequent obstacle to progress was on account of the rise in exchange rates during the past year, which was not accompanied by a proportionate reduction in wages, yet it resulted in the producers receiving less payment for their produce. Efforts were made to uphold prices for sugar sold within national territory, but this proved to be a transient palliative at the expense of the public, without bringing any permanent relief to the producer. It should be remembered that Brazil has been an exporter of sugar for a great number of years, but that now such exports must be able to compete with the beet sugar industry of Europe and also with the Cuban product, which enjoys a reduced tariff into the United States of America of 1·76 cents per pound, whereas other sugars pay 2¼ cents per pound.

The maintenance of unduly high local prices tends to create a false sense of international values, and the course of events has proved that it weakens the resources and recuperative powers of the industry when faced with a crisis. A co-operative effort has lately been essayed in the State of Pernambuco, and the sugar producers have been uniting their interests and allocating 600,000 bags of "Demerara" of the present crop for export. To do this, they feel constrained to solicit the aid of the State Government by remitting the export tax on sugar, in order to enable them to sell in foreign markets on a competitive basis. In Campos, also, conjoint action has been arranged for the supply of local markets.

Company Reports.

St. Madeleine Sugar Co., Ltd.—The seventh annual general meeting of the St. Madeleine Sugar Company, Ltd., was held in London last November, to present the accounts for the year ending June, 1926. The profits after payment of debenture interest amounted to £36,362, as against £3749 for 1924-25. In consequence, a debit balance of £65,233 brought in at the beginning of the financial year was reduced to £28,871, and there seem good grounds for hoping that this debit will be altogether wiped out by next June. The Chairman (Mr. G. MOODY STUART) stated that the notable feature of the crop under review was that it was raised under extraordinarily good weather conditions. The Trinidad 1925-26 crop was indeed a record one, amounting to 73,000 tons, or 33 per cent. above the average. Of this amount the St. Madeleine Company turned out 29,365 tons, also a record. Unfortunately prices for sugar fell to a low level, averaging £14 per ton, as compared with £15 13s. 4d. in 1925 and £24 14s. in 1924. The factory results (with the previous year in brackets) gave : sucrose in cane, 12·27 (11·70) ; purity of juice,

79·73 (81·85); recovery of sucrose, 83·95 (86·03); yield of 96° sugar, 10·74 (10·49); tons estate canes per acre, 20·58 (19·74). The purchase last year of La Fortunée estate has proved of great advantage to the Company, since, while not increasing the cane acreage of the island, it has provided the St. Madeleine mill with canes to produce 5000 more tons of sugar, and so has enabled the factory to run at fuller efficiency. The Board of Directors has been strengthened by the addition to it of Sir E. R. DAVSON, Bart., who takes the place vacated by the death of Mr. CYRIL GURNEY. The prospects for the coming crop fall considerably short of the past one since the extra-favourable conditions will hardly be repeated, but what is lost in quantity may conceivably be made up by the higher price for sugar that is indicated. The Directors therefore believe they can look forward to the future with confidence.

South African Notes.

According to the *South African Sugar Journal*, the crushing season in Natal which has just ended was at the end of November expected to total 242,509 short tons of sugar, which compares with an actual output last year of 239,851 tons,

One effect of the Millers' and Planters' Agreement just come to in South Africa is a decision to sell the whole of the sugar production (except that emanating from one group) through a single agency. The unfortunate result is that a number of sugar merchants and agents are being superseded and in some cases may have to go out of business, unless they can contrive to find other lines of agency work. The business of the leading sugar merchants and agents in Natal, Messrs. David Fowler & Co., Ltd., has, according to our contemporary, been acquired by Hulett's South African Refineries, the firm who are to handle all the sugar from now on.

The average price of First Refined sugar in South Africa for the twelve months ending October last has been £20 15s. per ton, a figure which includes the excise duty of £1 per ton.

It is officially announced that the German Government propose to increase the Customs duty on sugar from 10 to 15 RM. per 100 kg., and to reduce the amount of the internal tax thereon from 21 to 14 RM. per 100 kg.

A paper on "The Sugar Resources of the British Empire" will be read before the Dominions and Colonies Section of the Royal Society of Arts on Tuesday, January 25th, at 4-30 o'clock by Mr. BEN H. MORGAN, Chairman, Empire Producers' Organisation. The Chair will be taken by the Right Hon. L. S. AMERY, P.C., M.P., Secretary of State for the Dominions and Colonies. Tickets for the meeting may be obtained upon application to the Secretary, Dominions and Colonies Section, Royal Society of Arts, John Street, Adelphi, W.C 2.

For various reasons the price of sugar in the world's markets during 1925 was so low as to leave little or no margin of profit to Colonial sugar producers. In consequence they were compelled to limit their purchases of new machinery to the minimum. This, according to the *Glasgow Herald*, had a bad effect on the business of sugar machinery manufacturers in Great Britain, and such orders as were going encountered keen competition from makers in the United States and the Continent. In Australia and South Africa, as a result of the policy of fostering the industry by fixing a high selling price for internal trade, sugar manufacturers were not so badly affected by the low price of their commodity, and fair orders for machinery were placed in Glasgow for these two markets. Prospects are now better, following on a substantial rise in the price of sugar. This, with the more stable conditions ruling at home, makes the outlook more promising. Machinery manufacturers are, therefore, looking forward to receiving a good share of business during 1927. The firms in Glasgow engaged in this specialised branch of engineering are favourably known all over the sugar-producing world, and they were never better equipped than they are at present to execute large contracts.

British Beet Sugar Notes.

At the annual meeting of Tate & Lyle, Ltd., it was announced that the directors had decided not to go on with the proposed beet sugar factory at Selby, Yorkshire, as there seemed no probability that the industry would pay its way in the end. In view of the fact that the Tate & Lyle factory at Bury St. Edmunds is reported to have made a big loss—over £60,000—on its first years' working, this decision is perhaps not surprising. But that loss is only one more illustration of the difficulty of making new factories pay at the outset, before they have got accustomed to the special requirements of a continuous process of working.

Selby is however to have a factory all the same, as it is reported that the Central Sugar Co. of Peterborough (owners of the Dyer-designed factory at Peterborough) have acquired a site on the banks of the River Ouse at Selby whereon to erect a second beet factory. Guarantees of beet from the surrounding farmers are said to be sufficient to warrant success, and it is planned to open the factory next October. It will be owned by a separate company, the Selby Sugar Company, Ltd.

The Bardney project is reported to have received promise of support from the Government through the Trade Facilities Act. This Lincolnshire proposal, first brought forward over a year ago, had to be deferred for lack of this aid, but the financial difficulty would seem now to be overcome.

It was authoritatively reported last month that the Anglo-Dutch group had secured a site for another beet factory ; and it is now announced that this group have placed a contract for the erection of a beet factory at Kings Lynn to be ready for the 1927 crop. This contract has been secured by the firm of Fawcett, Preston & Co., Ltd., of Liverpool, and covers the erection of a plant capable of dealing with 1200 tons of beet per 24 hours.

After 12 years' association with the British Sugar Beet Society which he was largely instrumental in forming, Mr. ALFRED WOOD has tendered his resignation (to take place next month) of the post of Secretary of the Society. As is well known, Mr. WOOD's work has of late not been confined to the Society, he being also the Secretary of the Anglo-Dutch group of beet sugar factories, and with the increased pressure of work resulting he has found it advisable to sever his connexion with the Society and confine himself to his other interests. As Mr. ROBERTS, the chairman of the Society, said in announcing the news, Mr. WOOD has a fine record of service on behalf of the Society and the beet sugar industry generally ; but since he is not retiring from the industry the latter will obviously still gain the benefit of his wide experience.

According to an official statement in Parliament, the acreage returned as being under sugar beet in England and Wales this year was 125,814 acres, as compared with 54,750 acres in 1925. The total amount of subsidy paid to the beet sugar industry since the passing of the British Sugar (Subsidy) Act, 1925, is £2,681,946.

The new Peterborough sugar factory, built to the designs of the American firm of Dyer & Co., started operations on October 12th last, and in less than 30 days was operating at its rated capacity of 700 tons per 24 hours, while in November this figure was exceeded, and on November 24th as much as 832 tons was sliced in 24 hours.

The KING has for some time been a grower of sugar beet on his Norfolk farm lands. Being interested thereby in the subject, he accepted last November the invitation of Lord WEIR to go down to Colwick from London and inspect the beet factory of the Anglo-Scottish Beet Sugar Corporation while in active operation. The visit was entirely private, and the King was afforded every facility for seeing the complete *modus operandi* of turning sugar beets into white sugar.

The Home Sugar Trade during 1926.

Messrs. William Connal & Co's Annual Review.

Below we give the principal portions of the annual Report issued by Messrs. William Connal & Co., the well-known Glasgow sugar brokers, on the sugar trade during 1926. In part it relates to the Clyde sugar market.

Raws.—When the sugar market opened in January, Cuban sugars were quoted at 11s. to 11s. 3d. per cwt., and with moderate fluctuations these figures experienced little change till the end of August. In September, when it was realized that the statistical position had greatly improved, an advance took place of 1s. 9d. to 2s. per cwt., followed towards the close of November by a further advance of 2s. to 2s. 3d.—the quotation for Cubas being then 13s. 7½d. to 14s. per cwt., and on 10th December, when the decree had been signed by the Cuban President, restricting the coming crop to 4,500,000 tons, the quotation was raised to 15s. 9d. to 16s. 1½d. per cwt., establishing an advance of 5s. per cwt. on raw sugar during the year.

The effect of the restoration, by the present Government, of the preference of 4s. 3d. per cwt. on empire-grown sugar was fully realized early in the year. Sales of about 200,000 tons of Australian sugars had been made for shipment during the last six months of 1925, but from a strike in the Australian ports these shipments had been delayed, and their arrival in the U.K. took place principally during the early months of the year 1926. These arrivals, then, largely supplied the wants of refiners to the exclusion of Cuban sugars, which for several years had dominated the British markets during these months. In consequence, the importation of Cuban sugars to the U.K. from 1st January till the end of April only amounted to 69,750 tons, against 251,970 tons in 1925. The exclusion of Cuban sugars was more or less continued during the year by importations from Mauritius, Natal, British West Indies, as well as from Peru; the latter this year have been unusually abundant, having been about 120,000 tons, against 75,000 tons in 1925, and the total Cuban imports from 1st January till 10th December only amounted to 420,000 tons against 921,000 tons in 1925.

The market was depressed during March from poor demand, and the value of Cubans then gave way to 10s. 6d., c.i.f. The Cuban crop, then being reaped, was estimated as about 5,300,000 tons, and so serious had the Cuban position then become that, in view of the disposal of this record crop, planters felt compelled to appeal to the Cuban Government to place some restriction on its being fully reaped. Early in April they made their representation to this effect, which, after serious consideration, was agreed to, and on 29th April the President signed a decree limiting the crop to a maximum of 4,900,000 tons. Planters at the same time advocated the reduction of the two following crops, that over-production might be avoided. The quotation of Cubas in America at that time was 2¼ cents, cost and freight, New York—a price deeply disappointing to Cuban planters, who hoped that this reduction of the crop might lead to a higher, and more profitable level of prices. The poor demand for Cubas in the U.K. markets received some compensation from a largely increased demand from the Far East, and the exports to China, Japan, and India from 1st January till 4th December amounted to 246,000 tons, against 65,000 tons in 1925.

The firmness of the Java market at this time caused large purchases to be made of British and Continental refined sugars for India, to be shipped for arrival in India before new Javas were obtainable in May.

The Home Sugar Trade during 1926.

Fluctuations in the U.K. markets during the summer months were very unimportant, nor did the American markets then show any notable change. They ranged from $2\frac{3}{8}$ to $2\frac{13}{32}$, the equivalent of 11s. to 11s. 4d., cost and freight, New York. In the hopo of giving some additional assistance to Cuban planters, the Cuban President issued a decree on 23rd September prohibiting the cutting of canes of the coming crop till 1st January, 1927.

During September important sales of the new Cuban crop were made for the Far-East at 240 to 245, f.o.b.—about $2\frac{3}{4}$ cost and freight, New York—and India then also again became a buyer of Continental refined at 16s. to 16s. 9d., c.i.f., for October-March shipment. In September the improved statistical position favourably impressed the market—the American quotation had advanced to $2\frac{3}{4}$ to $2\frac{7}{8}$, cost and freight, New York, and this imparted some confidence to the U.K., where 13s. 3d. to 13s. 6d., c.i.f., had become the quotation for Cuba, followed by 13s. 9d. to 14s. at tho close of the month. These quotations were barely maintained during October and first half of November, notwithstanding the destruction wrought by the Cuban cyclone in October. On 18th November, however, when it was reported that the Cuban President had in view the reduction of the coming Cuban crops to 4,500,000 tons, Cuban quotations were advanced to 14s., c.i.f., and thereafter, when the decree had been signed by the President for the limitation of the crop, an immediate advance took place to 15s. 9d. to 16s. $1\frac{1}{2}$d., at which the market closed. American quotations were then also advanced to $3\frac{1}{4}$ to $3\frac{3}{8}$, cost and freight, New York. A considerable business in B.P. West India sugars was done. principally to English refiners at 15s., c.i.f., in January, thereafter at 15s. 6d., dropping, however, in April to 14s. 6d., and again rising with the advance in the market to 16s. 9d. in October, and latterly to 19s. 9d., c.i.f., for March-April shipments.

Mauritius sugar for the new crop commencing in August was largely secured for the British markets at 17s. 3d. to 17s. $4\frac{1}{2}$d., c.i.f., in June, the equivalent of 13s. to 13s. $1\frac{1}{2}$d., with preference deducted, and latterly business has been done in those sugars at 21s. to 21s. 6d., c.i.f.

The present Java crop, which commenced in May, proved inferior in quantity to the last, having only been 1,970,000 tons, against 2,275,000 tons in 1925, and it has almost entirely been absorbed by India, and Eastern markets. It now consists in great part of White sugars, suitable for those markets. The crop of 1927 is reported to have been already disposed of to the extent of 1,500,000 tons. Not only has the crop of 1927, which commences in May, been practically sold out, but a considerable part of the' 1928 crop has already passed into the hands of Japanese operators.

The Australian crop last year was very productive, and had a surplus of about 200,000 tons for exportation, but the present crop, having been reduced by drought, has only about 100,000 tons available for export. These have found buyers in the Canadian Pacific ports, and with British refiners.

During the past year two severe hurricanes have occurred, which proved disastrous to sugar plantations. The first was in Mauritius in April, which was said to have reduced the sugar crop by 20,000 to 30,000 tons ; the second in Cuba in October, which was of great severity, accompanied by loss of life, and much destruction of sugar property—the sugar loss being estimated at about 200,000 tons, with the addition of 30,000 tons in warehouse being destroyed.

In entering upon a new year refiners may possibly have less Continental competition to encounter in the sale of their refined. as the Czecho-Slovakia

crop—their principal opponent—is about 400,000 tons less than that of last year, and a proportion of it has been sold for the Far-East.

The melting of raw sugar in Greenock during the year has only been 108,750 tons—the smallest melt for the last sixty years. It was nearly as low in 1899, being then 114,595 tons, but at that time the German bounties and cartels had almost extinguished our sugar trade.

Consumption of the United Kingdom for the past three years has been as follows :—

	1926. Tons.		1925. Tons.		1924. Tons.
Meltings of raw sugar in London, Liverpool, and Greenock	820,000*	..	1,000,000	..	980,000
Probable consumption of Foreign refined	692,000	..	686,000	..	620,000
Home grown beet	100,000	..	—	..	—
	1,612,000	..	1,686,000	..	1,600,000

The following table gives a general idea of the sugar available for consumption for the coming year :—

	1926-27. Tons.	1925-26. Tons.	1924-25. Tons.	1923-24. Tons.
Stock in statistical countries carried over on 31st Aug...	1,500,000..	1,000,000..	1,000,000..	1,000,000
European beetroot crops	6,948,000..	7,470,832..	7,077,791..	5,057,761
U.S. and Canadian crops	838,000..	836,914..	1,010,385..	803,717
Cane crops..................	15,432,000..	16,106,455..	15,507,042..	14,250,343
	24,718,000..	25,414,201..	24,595,218..	21,111,821

The following table, embracing the above figures, is meant to give a rough calculation of the world's consumption during the past three years :—

	1926-27. Tons.	1925-26. Tons.	1924-25. Tons.	1923-24. Tons.
Visible supplies on 31st August, 1926, 1925, and 1924	1,500,000..	1,000,000..	1,000,000..	1,000,000
Production of beet and cane ..	23,218,000..	24,414,201..	23,595,218..	20,111,821
	24,718,000..	25,414,201..	24,595,218..	21,111,821
Deduct visible supplies on 31st Aug. 1926, 1925, and 1924	— ..	1,500,000..	1,000,000..	1,000,000
Total consumption for year ending 31st August	— ..	23,914,201..	23,595,218..	20,111,821

Refined.—Work in the Greenock refineries was seriously hampered from May till November during the coal strike. One refinery was silent during that period, and two worked intermittently. All three are again at work, as is also the ORCHARD SUGAR COMPANY, making sugar from beet. Another beet factory has started this year in Scotland, that of the ANGLO-SCOTTISH BEET CORPORATION, at Cupar, Fife.

For the first three months of the year price fluctuations of refined sugars were insignificant, but the market was firmer in April and May, owing to the decision of the Cuban Government to restrict the crop then reaping; even this had no great effect, and, as compared with the opening prices of the year, a rise of only 1s. to 1s. 3d. per cwt. was established. Until the latter half of September the market kept fairly steady, but thereafter, on reports that cutting of the Cuban 1926/27 crop would not be allowed before the 1st January, 1927, and also less favourable reports of the European beet

* Reduction accounted for by the reduced meltings by refiners during the Coal Strike.

crop, there were several sharp advances, with prices up about 2s. 3d. to 2s. 6d. on the opening. In October prices sagged, but in the second half of November the market developed great strength, and advanced about 2s. 6d., caused by reports of the 1927 Cuban restriction, and from further unfavourable accounts of Continental beetroot crops. Till the end of the year markets have kept very firm, and prices of refined sugars at the close show an advance for the year of about 5s. per cwt.

When the market opened in January, 27s. 3d. was the price of Greenock fine granulated, and early in February it had advanced to 27s. 9d. At this time India was largely buying European sugars, and several thousands of tons of Greenock granulated were sold for export. By the end of March the price had sagged to 26s. 9d., but the loss was made up in April, when there was talk of Cuban restriction. When the restriction to 4,900,000 tons actually took place 28s. 9d. was touched early in May. During the course of the coal strike there were times when Greenock quotations were more or less nominal, but 28s. may be taken as about the average price till well on in September. At the end of September it reached 29s., and early in October 30s. Thereafter till the middle of November 29s. 6d. to 30s. were the quotations, but then the market became strong on the proposed limitation of the 1927 Cuban crop, and there was almost an immediate advance of 2s., and at the close of the year the quotation was 32s.

Fine Dutch granulated started the year at 14s. 9d., f.o.b., and reached 15s. 9d. in May, after having dipped in the interval to 14s. 3d. In July the lowest quotation was 14s. 10½d., and there was not much change till the beginning of October, when it advanced smartly to 17s. A quieter period followed, and 16s. 1½d. was accepted about the middle of the month. Thereafter there were almost constant advances, and at the close the quotation was 19s. 6d.

Czecho sugars opened at 14s. 3d., f.o.b., fell to 13s. 7½d. in March, and with fluctuations similar to Dutch finished the year at 19s. For January-March, 1927, delivery the quotation is 19s. 4½d. There have been ample supplies available throughout most of the year, but in the last month or two Czecho refiners have shown little desire to press the sale of their sugars.

German sugars came on offer in August, but the quantity sold to the U.K. was not important, and now offers are practically withdrawn.

Canadian granulated has been imported in fair quantities, but little American has come. The imports of Transatlantic refined are much behind recent years, as their markets have generally been above our parity.

The principal event of the 89th convention of German Physicians at Dusseldorf this year consisted of several addresses on the new malaria remedy, "Plasmochin," of the I.-G. Farbenindustrie A.-G. Medical men and chemists of the Elberfeld Dye Works, Drs. HORLEIN and KOEHL, and Profs. SIOLI and MUHLENS, presented exhaustive reports on "Plasmochin," based upon practical experiments on malaria in the most varied climates. Experiments on replacing quinine, with its bitter taste, and numerous secondary effects on the organism by other malaria remedies have hitherto been unsuccessful. But the new remedy developed by Dr. SCHULEMANN, Dr. SCHÖNHÖFER and Dr. WINGLER, is derived from quinoline and is entirely a synthetic product. Its action is based upon a parasitotoxic effect. The parasites are injured, their development is inhibited, and they then succumb to the natural defensive mechanism of the host. The preparation is almost completely tasteless. Secondary effects, as in the case of quinine, were barely noticed, although with higher doses a certain caution is advised. For the first time with a malaria remedy it was noted that the perennial forms of *Malaria tropica*, the so-called half-moon shaped types, were destroyed. In the case of malaria relapses use was made of a preparation "Plasmochin compositum" that contains small amounts of quinine with the "Plasmochin."

The Sugar Industry in Queensland.

By J. F. REID.

Queensland's sugar production last year showed an increase on previous returns. Of the total Australian manufacture of 505,000 tons, Queensland's quota was 473,000 tons. The area under cane is now over 280,000 acres which are cultivated by more than 6000 growers. The total yield was in excess of Commonwealth requirements by about 200,000 tons which had to be exported at a reduced price. As a consequence prices generally were lower to the grower than in the immediately preceding seasons.

A new development is the creation of a Cane Growers' Council, elected by suppliers to every mill in the State with the object of ensuring to them a wider control over their own industrial affairs and giving them power to fix their own levies.

A notable event in the course of the year was the opening of the Tully River Mill which is now the largest and most complete in Australia. The machinery and general working plant of this new enterprise was manufactured almost entirely locally. This fact may be accepted as an indication, also, of solid progress in our secondary industries. Around the mill a flourishing township has grown, and on its tributary territory a large population has settled on what was, until recently, dense, jungle-covered country. In addition to the cost of the new mill something like £1,000,000 has been expended in the course of the last quinquennial period on increasing the capacity and improving the efficiency of other Queensland mills. On the science side, to assist in combating pests and diseases, additions have been made to the entomological and pathological staffs, while provision has been made by the Government for training students at the Queensland University. A number of students have also been awarded Oversea Travelling Scholarships.

New Legislation.

A short Sugar Works Act Amending Bill occupied the attention of the State Legislature for some time this session, and has since become law. An alteration of the method of levying taxation in the districts served by the Johnstone River and Tully River Mills in the North was the principal object of the measure. The original Act of 1911 made provision for levying, if necessary, on all occupied land within those areas and, through what was obviously an oversight, or, one should say, a remarkable lack of foresight, in not anticipating the day when local production would exceed the capacity of these mills. to make good any deficit on their year's operations. It was sought to correct the unfairness of levying on lands on which permits to grow cane had been withheld.

Sugar-growing in the areas affected is subject to the will of the local mill management, which, owing to the risk of over supply of cane, has been forced to limit local plantings. It is necessary, however, to make clear that cane growing permits in these districts have not been restricted because of surplus production, but because of the incapacity of the mills to treat all the cane that could be grown locally. In any given year cane cultivation is limited to the capacity of local crushing plants and in the districts affected experience has shown that the incidence of the levy is inequitable. Away back in 1911, evidently, the extraordinary expansion of the industry, particularly in recent years, was not foreseen. Production has already overtaken crushing capacity and even if in the aggregate there were an under-production of cane those

mills would still be incapable of crushing the whole of the crop that could be taken off local lands. consequently the removal of restrictions on local production, that is the issue of further cane planting permits, would be quite useless. Under the new legislation levies may be imposed only on farmers actually engaged in sugar cultivation and not as a general regional impost as heretofore.

THE CENTRAL SUGAR MILLS.

The General Manager of the Bureau of Central Sugar Mills, Mr. W. J SHORT, reports a loss on its operations for the 1925 season. In the course of a general survey he ascribes this unsatisfactory position of the Government controlled mills largely to the very low price of sugar, and mentions other contributing factors. Only just over 56 per cent of the whole Australian production was required for home use, the balance being marketed at world's parity. Industrial disputes in which transport and waterside unions were involved necessitated extensive storage of sugar. The coincident oversea shipping trouble accentuated difficulties by blocking the export of the surplus. These regrettable business disturbances contributed to operating losses. The 1926 season, in respect to price particularly, is opening more promisingly, but as this is due to abnormal dryness the factories controlled by the Government will again be affected adversely.

Four of the mills operated by the Sugar Bureau came into possession of the Government by default. principally because of their being placed in unsuitable localities. Through the extension of the Cane Prices Act to these mills, the Bureau has had to pay the ruling price for cane in the areas from which they draw tribute. It is not argued, of course. that cultivation costs are not as great in these districts as in those served by mills situated more centrally. In fact, they are sometimes higher because of comparatively poorer crop returns. Though the Act states distinctly that the grower shall not suffer on account of mill inefficiency, it also provides specially that local conditions must be considered when determining prices.

The Central Cane Prices Board, in giving judgment for this season, states :—" The Board, however, find much difficulty in dealing with certain mills, more particularly Government controlled mills, which have been taken possession of by the Government. These mills, on account of their ill-selected location and their inadequate capacity, cannot be profitably carried on at the price fixed for cane. A possible solution of the difficulty would be an agreement between millowner and growers, as in the case of the Cattle Creek Mill at Mackay, by which the growers agree to accept a reduced price for cane, and which agreement has been approved of by the Board. The Board cannot fix a lower price for these mills than for the other mills in the district, without departing from district uniformity, which is not considered advisable. The Board recognises that this decision may result in the closing of some mills, but no doubt arrangements to take over the cane supply could be made with other mills in the neighbourhood. For instance, Bingera and the Bundaberg Mills are conveniently situated with reference to Gin Gin suppliers, Maryborough, Isis and Moreton Mills with reference to Mount Bauple suppliers and Marian to North Eton suppliers."

In the circumstances it is proposed to avoid further loss by the Treasury in respect to these non-paying mills by closing them down. Next year's crop on present appearances, will also be a light one, so a continuance of operations would involve further losses.

SURPLUS PRODUCTION.

Weather conditions this season have had an important bearing on the difficult problem of surplus production, but as a consequence of continued dryness in the sugar districts causing a reduction in the probable exportable surplus the problem has to some small extent settled it itself temporarily.

Early in the year, to deal with the difficulty, at a Conference of Cane Growers, a scheme was devised under which it was sought to ascertain definite Commonwealth requirements at the Australian price, say, £26 per ton. It was proposed to acquire the balance of sugar manufactured during the season at the estimated price of realisation when sold for export. In allocating to each mill its proportion of sugar it was suggested that the Board should take as its basis the mean of the sugar actually manufactured last season and that estimated to be manufactured during the present season, should the whole crops be harvested, any necessary adjustments being made. Should it be found necessary for the effective working of these proposals the creation of separate Pools—" Sugar for Home Consumption " and " Sugar for Export " was also planned. The allocation arrangements were to be left to the District Cane Growers' Councils, Mill Suppliers' Committees and Local Cane Prices Boards.

Difficulties in operating the scheme successfully were not overlooked. They were not regarded as insuperable, however, and an effort to ensure the fullest co-operation between the Government and the Sugar Board in carrying into effect the decisions of the Conference at which the scheme was promulgated was advocated. The Commonwealth Bank was mentioned as a medium through which financial arrangements might be made. Against this scheme it was contended that it would operate unjustly, for it would not overcome the differences that exist, not only as between districts, but as between mills in the one district. For instance, a grower who might have increased his area, or, for that matter, a new grower for the 1926 season may, because he is a supplier to a mill in a poor district climatically, secure a higher price for his cane, on account of his mill receiving a higher price for its sugar by reason of a smaller district crop

As an example take the ex-soldier settlers at Maria Creek and the South Johnstone growers who for some years have not been allowed to increase their individual areas. Because the ex-servicemen are transferred to the Tully region, the combined area—the mills assist each other in crushing—will be paid the Australian price for 59·5 per cent. of the crop and 40·5 per cent. will be sold at world's price; but if Tully were taken separately, the ex-soldiers would receive only 43 per cent. at the Australian price, while at certain Southern mills the growers—whether new or old, large or small—will obtain the Australian price for the whole output. This is in effect an insurance against droughts, frosts and other worries of the sugar grower, without payment of the premium.

In view, also, of the agreement between the Commonwealth and the State by which the Queensland Government purchases all sugar manufactured in both producing States up to next year (the term of the agreement covers the seasons 1925-1927) it has to be considered whether some of the proposals embodied in the scheme do not amount to a breach, either in letter or spirit. There should, too, be no reason why the New South Wales crop should not also be covered, and it would be unwise to do anything that might raise difficulties between the two States concerned or, even between divisions in our own State.

It is regrettable that the invitation of the Central Cane Prices Board last season to those concerned to submit suggestions on the subject of the

curtailment of assignments met with little response. The erection of the new mill at the Tully river has aroused some criticism of Government policy in this regard, but this mill is part of a general developmental programme for North Queensland, one of our most fertile and, perhaps, vulnerable regions. A modern sugar mill in North Queensland, from a defence point of view, is more effective than a modern battleship and it means probably another battalion of potential defenders.

Getting back to the allocation scheme as propounded at the Cane Growers' Conference referred to, if its objective were reached over-production in the more favoured districts would cease, but if a dry spell or a hard frost occurred (they occur and recur inevitably) in the southern canefields, followed by serious crop reduction, we might find ourselves in the position of having to rely on importations to make good home shortage. Our claim for a continuation of the embargo on black-grown sugar would, in consequence, be naturally weakened.

It must also be remembered that, though we have an embargo on sugar from overseas, the production of labour living under conditions lower than those of Australian standards, we have not altogether a monopoly. Districts that are more favoured by nature must progress at a greater rate than those to which nature has not been so kind, and any attempt to offset artificially sound economic factors must have a boomerang effect.

The Government is evidently not disposed to ignore the fact that additional labour is required to take off the surplus crop. The question of keeping men employed, of course, no Government can ignore. The export of the surplus, even at a price lower than that of the sugar consumed at home, is of some benefit to Australia, though it is admitted that, under existing arrangements, the sugar grower has to pay for that advantage.

Officially it is not argued that curtailment of areas is reducing the country's wealth, for if production does not realise cost, it can scarcely be described as wealth. It is recognised that while producers may, by arrangement, curtail areas voluntarily, to lessen by regulation production and consequential employment is a serious thing for a Government to do.

We learn through the oversea Press that restrictions on planting areas are proposed in Cuba, and possibly in other sugar producing countries. In Queensland, from a purely State point of view we have to walk warily, for satisfactory conditions here are more or less dependent on the good will of the Southern States ; commercial influence there is very strong and any legislative or regulative action must be considered carefully lest we incur a forfeiture of that goodwill.

The underlying motive behind the Cane Growers' Conference recommendations for the adoption of its proposals, however, is worthy of sympathy : that is the right of a man to refuse to harvest a crop at a loss, whether through deficiency in price or quality.

The Australian Price of Sugar.

Under the agreement between the Commonwealth and tho Queensland Governments, the price of sugar contained in manufactured goods exported from Australia is determined by the Export Sugar Committee. That body, comprising Messrs. A. R. Townsend, G. H. Pritchard, and S. Berchdolt (representing the Commonwealth, the sugar industry, and the manufacturers respectively), met in Melbourne recently, and fixed the export sugar rebates as from November 1st at £10 15s. a ton on fruit products, and £17 a ton on all other goods. The lower rate on fruit products is due to the fact that

sugar is supplied to manufacturers of such products for home consumption at £6 5s. 1d. a ton less than to other manufacturers.

CROP ESTIMATE.

Revised estimates show that the Queensland crushing for this season is expected to amount to 3,000,000 tons of cane. Northern estimates have increased, but there is a decrease in figures in respect to country south of the Herbert River. This always happens in abnormally dry years and emphasizes the especial suitability of the northern jungle lands, or rain forests soils as the botanists like to call them, for sugar culture. Up there dry year yields are always better than those of very wet seasons, while droughts are unknown. For instance, the Tully area, in what is called generally a very droughty year, the rainfall for 1926 to the end of October has amounted to 87 inches.

POWER ALCOHOL.

The manufacture of power alcohol, the fuel of the future, is intriguing many commercial minds. The new plant at Sarina is well forward and suitable crops are being grown for treatment, particularly cassava, and sugar by-products will also be brought under tribute. The possibilities of molasses can be measured by the fact that of our approximate annual production of 18,000,000 gallons, 6,000,000 gallons are allowed to run to waste. The balance of 12,000,000 gallons is used in distillation, stock feeding, manuring and furnace fuel. In this connexion American figures are interesting. The statistics at present available show that in the United States the seventy-one factories operating produced in the year 1924/5, 87,455,535 gallons of power alcohol as against 1,780,276 gallons produced in 1906/7 in eight factories. In 1924 (no later figures are available) the United States utilized 228,160,499 gallons of molasses. Allowing good raw material to run to waste is obviously an economic crime.

VISITING DELEGATIONS.

The Imperial Press Delegation and, more recently, the Imperial Parliamentary Delegation have toured Queensland. Each group was given an opportunity of seeing White Australia at work in our chief tropical industry. The pressmen had, perhaps, the benefit of a better informed ciceronage during their travels through the State and were apparently impressed deeply with the success that has attended what they regarded as an experiment in tropical settlement and production by white labour. The Parliamentary people, if one may judge from the subsequent pronouncements of some of them, were allowed to absorb much wrong information about the sugar industry in the course of their wanderings. This was naturally the result of the official view, or what seemed to be the official view, that the tour was in the nature of a Parliamentary picnic. The visit of the Delegation provided an obvious opportunity of making its members, and more important those whom they represented, *au fait* with the process of translating the ideal of White Australia from the realms of academical argument to the field of actual fact. Extraordinary as it may seem, no representative of the sugar growers' organisations was invited to join the party in its tour of the North, and the visitors' only sources of information were the people whom they met in a more or less social or official way, and others whose practical knowledge of rural industries is not particularly profound. The sugar industry in Queensland is worth something like £14,000,000 per annum in the value of its raw products, and it was a pity that some at least of our visitors were allowed to absorb and go away with ideas that were quite wrong. For instance, one of them, drawing a comparison between retail prices of sugar in New Zealand

Java, of which considerable quantities were imported at 15s. per cwt. The boycott of British and Japanese goods gave considerable impetus to Cubans and Java sugars, prices varying from 18s. to 15s.

There is no doubt that China is a huge market for sugar, and, as in other commodities, presents an excellent field for development. What, then, are the possibilities of China figuring as one of the world's important sugar-producing countries ? The most important areas lie in the present disturbed provinces, namely in the South. But undue pessimism should not be attached to this factor, as China has for centuries been in a disturbed state, and in spite of this, her trade has steadily increased. What is more important for the development of her sugar industry is the introduction of modern methods, sufficient capital, and a better understanding of Chinese mentality and her customs on the part of foreigners trading with her. Until modern methods are introduced, it is unlikely that China can become self-supporting, although she has the soil and cheap labour in abundance, sufficient to supply half the world with sugar cane. Lack of transport and other means of communications from the interior to the coast is a difficulty which time will solve, for the Chinese are born traders and nothing will stop them from overcoming difficulties and marketing their products, as long as there is a profit in them. Up to the present time, the West has not taken any notice of China as a possible sugar-producing factor. At the moment, people are more interested in the increase in demand from that quarter ; and added to this, with the South of China (Canton and the Cantonese) absorbing the world's attention so far as China is concerned, Northern China, namely Manchuria, has fallen into the background. But it is just there where the most progress has been and is being made, especially in sugar cultivation and refining. In 1917 the Japanese established in Mukden a factory (called the South Manchurian Sugar Refining Co., Ltd.) with a capital of about £1,000,000. Beet is cultivated over an area of 6,127 acres, yielding approximately 132,280,000 lbs. or 52,912 lbs. per acre ; about 10 per cent. crude sugar is exported. It is stated that in Manchuria one acre can produce 35 cwt. of beet containing 15·34 per cent. sugar. The Japanese not only refine the sugar in Manchuria, but also manufacture alcohol as a by-product. Japan imports a large quantity of German and American seed for planting beet in Manchuria, the soil in the locality of Mukden and Harbin being most suitable. Besides the Japanese enterprise, there is also a Russian factory manufacturing refined sugar to the extent of 3,000 tons annually, and a Chinese concern near Hulan, North Manchuria. The Japanese and Russian factories are a success, increasing their output every year, whilst the Chinese one has been not nearly so successful, owing, it is said, to mismanagement. As regards the Japanese factory, the beet cultivated supplies the refinery during the winter months, and crude sugar is imported for refining during the remainder of the year.

In conclusion, an ever-increasing demand may be safely anticipated from China, but only so long as her own industry remains in the little developed state it is in at present. When development on modern lines takes place, China will become an exporter of sugar instead of purchaser ; and the first to lead the way will be Manchuria, the land of the Soya bean. Sugar producers would do well to investigate conditions in that immense country, as it is the most fertile and the least disturbed section in the Chinese Empire.

A cargo of 3200 tons of Polish sugar recently left Danzig bound for China. The shipment was of an experimental character to determine whether Poland can actually compete on that market with sugar from Java.

table shows the share different countries supplied China with in the most usual qualities :—

	SUGAR, BROWN. PER CENT.		WHITE. PER CENT.		REFINED. PER CENT.		SUGAR CANDY. PER CENT.
Hongkong	66	..	55	..	50	..	77
Dutch East Indies	10	..	36	..	1	..	—
Japan (including Formosa and Korea)	7	..	7	..	46	..	15
Philippine Islands	16	..	—	..	—	..	—
Other countries	1	..	2	..	3	..	8
	100	..	100	..	100	..	100

Shanghai and Hankow are the most important sugar markets ; dealers from several provinces have buying offices established there, as well as in Hongkong and Swatow. There are only comparatively few foreign firms dealing in sugar in China ; among the most important are JARDINE MATHESON & Co., LTD., BUTTERFIELD & SWIRE (both of which are British concerns), MITSUI BUSSAN KAISHA, SUZUKI & Co., LTD., and MITSUI BISHI KAISHA. All these import refined sugar into China, the British sugar refined in Hongkong or elsewhere, and the Japanese sugar refined in Japan. Most of the sugar candy is imported by BUTTERFIELD & SWIRE, and comes from Europe, business at present being particularly brisk, especially with Belgium. Hongkong draws her principal supplies of raw sugar for refining from Java, Philippine Islands, and the South of China (Swatow).

Sugar is graded as follows : White sugar, refined sugar, and sugar candy, which have quite a number of names and grades ; Swatow sugar is divided into 19 grades, Hongkong sugar candy 3 grades, Japanese sugar 8 grades, and British refined sugar (Hongkong) 9 grades. Sugar candy imported from abroad is not graded.

The procedure of transactions in sugar in China is not intricate ; after arrival of goods into the godown (warehouse or place for storing merchandise, of which every firm of any importance has at least one), the buyer instructs the godown keeper to have them delivered. Foreign imported sugar is delivered cash against payment. Chinese dealers allow one another 15 days within which to pay. It is not difficult for foreign houses to trade on this basis of cash, but this is not the case with the Chinese dealer, who, when distributing his sugar into the interior, has to pay likin (transit tax), and the tax which is collected by the agents of the Chinese Government. Methods and terms of payment among the Chinese merchants and dealers, however, vary according to location and local practices. Chinese sugar merchants do not confine their attention to sugar only ; they also deal in other commodities, such as pepper, fibre, beancakes, fishery products, and even silk and similar materials.

Chinese are great eaters—that is, when they can afford to be, the majority of the Chinese masses being extremely poor and having to content themselves with rice and beans—and have excellent cooking à la Chinoise. They still drink their tea without sugar and there is no likelihood that they will change to adding sugar. But sugar is being, more and more, used in their different foods, confectionery, and other preparations. Thus, the demand depends on the price ; when the price of sugar is low, the consumption is high. The year 1925 is an example, as during that period, owing to the keenness of competition from Japanese refiners, Hongkong refiners had to cut their prices to an unusually low figure, with the result that consumption increased. The cheapest sugar offered on the market during last year was

limited the market of sugar produced in the interior of China to the locality only.

There are about 17 refineries of any magnitude in the whole of China, the principal being the China Sugar Refining Co., with two factories at Hongkong, and the Taikoo Sugar Refinery also in Hongkong, both British firms; next in importance comes the South Manchurian Sugar Refining Co., Ltd., in Mukden, which is a Japanese enterprise; and there is a Russian factory near Harbin, also of some importance. All these foreign refineries employ modern methods of manufacture, and thus have been successful in establishing a firm foothold in China's sugar trade. As to Chinese enterprise, there is an untold number of Chinese sugar plants using old methods, particularly in South China. Their process of manufacture is still the same as it has been for years and is briefly the following :—

Sugar cane is pressed in a mill, and the juice extracted is slowly heated in special distilling pans—bagasse being used as fuel—until it becomes a syrup. The syrup is then heated in the sun to form Tsing T'ang or molasses. It is extremely sweet, sold at a low price, and used in the manufacture of refined sugar. The old method of separating molasses into white sugar and brown sugar consists of pouring molasses into an earthenware jar and sealing the mouth with moistened clay. After a certain length of time, the molasses is settled into two layers with white sugar on top and brown sugar underneath. Molasses is classified into three kinds: Hongkong molasses, Swatow molasses, and Formosa, the latter being shipped mostly to Japan for refining.

Whilst Japan has made remarkable progress in the refining of sugar grown in her colonies and has thus become the third largest supplier of the Chinese market, China whose production of sugar cane could exceed that of any other country—her average yearly production is one million tons—is importing more and more sugar every year. The reason for this anomaly lies in the fact that old methods of cultivation and manufacture still prevail; and until improved methods of cultivation and preparation are introduced, China cannot compete with Java or Japan. Thus, with the ever-increasing consumption of sugar in China, imports will increase, the field for foreign enterprise—for the merchant, financier, and manufacturer of machinery—is extensive. The following table shows China's imports of sugar during the past two years :—

	1924. Tons.	Value. £	1925. Tons.	Value. £
Sugar brown, under No. 11 Dutch standard	115,659	1,910,000	133,847	2,607,000
White, over No. 10 Dutch standard	154,159	3,420,000	250,293	5,827,000
Refined	263,813	6,337,000	274,350	5,918,000
White, cube and loaf	705	32,200	1,411	55,250
Candy	21,876	700,000	22,823	651,000
Other kinds	78	7,000	420	34,900
Molasses	14,883	60,300	7,395	31,230
Total	571,173	12,466,500	690,539	15,124,380
Sugar cane	8,495	35,610	9,272	28,520

The following countries were in 1925 the principal suppliers of the China market for sugar: Dutch East Indies with 229,173 tons; Hongkong with 226,756 tons; Japan with 166,537 tons, and the Philippine Islands with 37,569 tons. Taking the past few years as an average, the following

sugar of first quality, 3550 tons, against 3677 tons in January-June, 1925; and 6214 tons in January-June, 1924; sugar of second quality, 505 tons in January-June, 1924; liquid glucose, 3 tons, against 0·5 ton in January-June, 1925, and 1 ton in January-June, 1924; solid glucose, 2 tons against nothing in preceding years.

China's Sugar Trade and its Possibilities.

By WALTER BUCHLER.

Far-Eastern markets, China in particular, have recently shown considerable activity in buying Continental supplies of refined sugar. So much so, that China is, at the present time, considered one of the principal factors in the recent development of a better feeling and gain in confidence in the sugar market. The demand from the Far East shows every likelihood not only of continuing, but also of increasing. Internal strife in China is bringing the Far East more and more to the notice of the West, but the pessimism displayed by the press shows what a hazy knowledge Europe has of conditions in China, nor does it encourage trade, which, in spite of the so-called "wars" in China, still continues. Were matters as serious and injurious to trade as the press depicts them to be, there would be no demand at all for sugar from China, whereas the position is just the reverse. A review of China's sugar trade and its possibilities will help those interested in that commodity to understand the importance of that market and the scope it provides for private enterprise.

China has cultivated the sugar cane for centuries, and it was Chinese who introduced it into Java, the Philippine Islands, Formosa and Japan; and one finds that in the 18th century a fair amount of Chinese sugar was shipped to New York. Sugar has always been regarded in China as a luxury, and often constituted the tribute to the Emperor from those provinces that cultivated it. Eating sugar cane in its raw state is, even to this day, still more popular than is its general use in a refined or semi-refined condition; and the art of manufacturing sugar was acquired in the 7th century (between the years 627-650), when the Emperor TAI TSUNG sent people to Behar, in India, to learn this art. The Chinese soon learnt how to prepare a kind of sugar and, from that time onwards, the art of making sugar out of cane spread rapidly. The actual art of refining is, however, said to have been brought to China from Egypt. When MARCO POLO visited China in 1270-1295, he found that the Chinese prepared a light-coloured kind of sugar by drawing off the raw molasses. This enabled the sugar to be sold at a very low price. Sugar cane is found almost everywhere south of the Yangtsze River, in the provinces of Eukien and Kwangtung; it is also cultivated in the provinces of Szechwan and Shantung, whilst beet is grown in Manchuria, the land of the Soya bean. There are three kinds of sugar for which there is a demand in China: Szechuen sugar, Swatow sugar, and refined sugar. That imported from Szechuen is known as "barrel sugar," being packed in wooden barrels. Szechuen and Swatow sugars are of a yellow and white variety, and both are very sweet. The sugar trade in the South of China is mostly in the hands of Cantonese, about whom so much is nowadays heard. Most parts of China possess suitable soil for growing sugar cane or, as in the North, beet. But production has been limited in those areas where there is a lack of railway or water communications. Difficulties of transport and the heavy likin (transit tax) imposed between different provinces during recent years have

The Italian Sugar Campaign of 1926–1927.

By R. SANSONE.

The Italian sugar industry, after having overcome the crisis of the last year, is proceeding in its return towards normality. The campaign of 1926-27 is now completed by nearly all the factories. At the end of October, those of Avezzano and Foligno were still in activity, as they had to treat a delayed crop of beets coming from fields in upper zones, where the roots mature more slowly. During this campaign 49 factories have been at work out of the 54 existing, while in the campaign of 1925-26 only 34 were in activity. The beets produced on the 80,000 hectares sown will amount to about 280,000 metric tons, with a mean production per hectare of 35 tons, that is superior to what is obtained in normal times, or last year (140,000 tons). The beets were of very good quality, the favourable weather having added much to the sugar content of the roots, which are everywhere reported to have been more than 10 per cent. above the normal.

The joint production of white sugar will, it is expected, be about 275,000 tons, and if to this are added the balance of the preceding crop, reaching 6900 tons, the total amount disposable will be some 281,900 tons, against an annual consumption of 320,000 tons. About 40,000 tons of sugar need therefore to be imported for satisfying the total needs. The results obtained are quite above the first forecasts made on the basis of the areas sown. These, with a normal harvest, would not have given a production of sugar greater than 240,000 tons.

The acreage sown with beets, which had fallen in 1925 to 50,000 hectares, rose in the 1926-27 campaign to 80,000 hectares, and it is considered that next year, given the smaller yields and profits made by other crops, especially that of hemp, the sowings of beet will be so extensive as to yield a production covering the entire internal needs.

In the meanwhile sales proceed rapidly, favoured by the more sustained foreign prices (3000 lire per ton for refined sugar and 2700 lire per ton for crystallized sugar, with 4000 lire of Government tax). Good trade balances are expected for these reasons by the sugar factories. Speculation has been little in evidence on the Italian market, which has, as a rule, run its normal course. The closing of the largest sugar refinery in London permitted a better sale of the national product, through some increase occurring in the price of imported sugar.

In view of the very good results of the analysis of the beet seed coming from Ukraine beets (they gave a maximum yield of sugar and a minimum content of impurities), the Italian growers have encouraged the Russian representatives in Italy of the U.R.S.S. to take steps to increase their imports of this Russian brand of seed.

The Italian sugar imports during the first six months of this year were as follows : Molasses 2358 tons, against 1950 tons in January-June, 1925, and 3295 tons in January-June, 1924 ; sugar of first quality, 6693 tons, against 65,696 tons in January-June, 1925, and 4559 tons in January-June, 1924 ; sugar of second quality, 12 tons, against 0·3 ton in January-June, 1925 and 0·1 ton in January-June, 1924 ; liquid glucose, 144 tons against 92 tons in January-June, 1925, and 29 tons in January-June, 1924 ; solid glucose, 0·4 ton, against 0·6 ton in January-June, 1925, and 4 tons in January-June, 1924.

Italy exported during the above months of 1926 0·1 ton of molasses, against 0·3 ton in January-June, 1925, and nothing in January-June, 1924 ;

Horse-Power for Cane Mills.

By P. H. PARR.

In an article on "Milling Plant Performance Estimations,"[1] the writer gave a table showing approximately the power usually absorbed by the standard sizes and combinations of cane crushing mills; and also indicated a suitable allowance for the power of the driving units.

For designing purposes, however, it is very useful to have a complete table of the horse-powers to be allowed—to cover the peak loads—as well as of those usually required in working; and the accompanying table gives the brake horse-power which should generally be allowed for, from the driving engine or motor, for all standard sizes and combinations of cane mills.

The values in the column headed "1-roller" refer of course to cane knives, and are sufficient for operating heavy "cutting" knives, of the Meinecke or other type; for "levelling" knives, about half of the tabulated power is ample.

The "2-roller" column refers to crushers, and the "4-roller" column to double crushers worked by one engine. The other combinations are obvious, and do not require further comment.

ENGINE B.H.P. FOR CANE MILLS.

	Number of Rollers.								
Mill.	1	2	3	4	5	6	8	9	11
12·18	2	5	7	7	9	11	13	15	17
14·21	4	7	11	12	15	17	21	23	27
16·24	6	11	16	17	22	26	32	35	40
18·30	9	17	25	27	35	40	50	55	65
20·30	11	21	31	34	45	50	60	70	80
20·36	13	25	37	40	50	60	75	80	95
22·36	16	31	45	50	65	70	90	100	115
22·42	18	36	50	55	75	85	105	115	135
24·42	22	40	65	70	85	100	125	135	160
24·48	25	50	70	75	100	115	145	155	180
26.48	30	55	85	90	115	135	170	185	210
26·54	33	65	95	100	130	150	190	210	240
28·54	38	75	110	120	150	175	220	240	280
28·60	45	80	120	130	170	195	240	270	310
30·60	50	95	140	150	195	220	280	310	360
30·66	55	105	155	165	210	240	310	340	390
32·66	60	120	175	190	240	280	350	380	440
32·72	65	130	190	210	270	300	380	420	490
34·72	75	145	210	230	300	340	430	470	550
34·78	80	160	230	250	320	370	460	510	590
36·78	90	180	260	280	370	420	520	580	670
36·84	100	190	280	300	390	450	560	620	720

The table has been filled in completely, although a number of the combinations are not likely to be required in the smaller sizes; nevertheless, the writer knows of a 5-roller mill as small as 10 in. × 15 in., and of several 8 and 11-roller mills with 16 in. diam. rollers.

Modern experience shows that, even for quite small plants crushing only three or four tons of cane per hour, it pays to put down mills of heavy design, with at least five rollers, and better eight, as the additional extraction soon pays for the extra first cost of the machinery.

In a future note the writer hopes to give tables of standard horse-powers as given by the usual sizes of steam engines.

[1] *I.S.J.*, 1922, p. 250 *et seq.*

of multiplication. The method, first adopted in 1918 with 2714 and 2725 POJ, appears to be as follows: Shoots about 2½ months old are able to produce their own roots and therefore can be planted; when this is done young plants are growing which also produce shoots, and these are detached and planted as soon as they are old enough. Thus a nursery of plants of varying age is established, and multiplication is very rapid. The method is termed "seblangen" and, incidentally, gives a good deal of information as to the growth capacity of a kind. A cane which "seblangs" well, is one of rapid development and strong rooting powers, especially when planted from the upper portions of the cane, and such a kind is usually called a strong one by the planters.

During the second year, because of the greater number of plants, it is possible to distinguish between accidental and permanent characters, and for this reason a number of forms are discarded in which the character in the seedlings proves to be transitory. The true amount of tillering and flowering is also more readily estimated. Then, germination of the set and early growth can be studied, and it is possible to form an opinion of these characters within the first two months. Shortly before flowering, i.e., in February, the general characters of growth and of the leafy crown are well seen, and these are noted; and the third and last selection for habit follows in May, after flowering. The same characters are studied in the second year as were in the first. For juice analysis, 10 canes are marked for the mill, about the middle of May, in each kind; good, poor and medium being included. The analysis of these is done twice, namely in June and July, so as to obtain information as to early and late ripeners, five whole canes being used on each occasion. The final selection of the year is made after the second analysis, and the total number of survivals rarely exceeds one quarter of those chosen in the first year. All of the canes are analysed in the second year, in spite of any rejections during the year, in order to obtain general criteria regarding all of those selected in the first year. If any of the "maximalisten" give promise of being better than the standard canes grown, steps are taken to multiply them as rapidly as possible, so that plantations may be able to obtain seed early, if they wish to. As an example of the results obtained by the method (already described), 2878 POJ may be cited; in 1922 there was one full grown plant, in 1925 there were 1750 bouws, and in 1926 about 25,000 under this variety.

The third year's selection.—The seedlings are planted now in a greater number of furrows, usually 2-10; and the furrows extend right across the plot, so as to be on both sides of the pathway. The plants on the two sides receive different amounts of ammonium sulphate, one the same as in the first and second year, and one half as much. The idea here is to obtain information as to how the seedling will behave under better and worse conditions; but it is confessed that the method has not as yet given very definite results. The principles of selection are similar to those in the second year, and 10 canes are crushed of each variety on each side of the path. Until the end of the third year, each kind retains its original first year number, but those few which survive at the end of the third year enter the list of POJ canes. Further testing now takes place on the plantations, in order to compare the new seedling canes with those being grown. After a 30-fold harvest made in this manner, it is considered possible to judge, with reasonable certainty, what importance a seedling has for the industry at large.

C. A. B.

(groeibarsten) should be rejected. In many seedlings the root eyes tend to protrude early. If inherent, this should be a definite bar ; but it may depend upon whether the canes are free-stripping. When they are not, insect enemies find shelter, water collects and fungus disease is likely to prevail ; besides which, additional labour is needed for stripping at harvest.

In many batches, the buds tend to protrude from the stem, especially when they are long, and this courts damage, especially in the handling of the sets. Shooting at the top characterizes many flowering canes, but it is also present in others, and is of course undesirable. The form, colour and position taken up by the leaves are of considerable importance. Broad leaves, widely spreading, are preferable to narrow erect ones, for metabolic reasons. Spreading leaves get much more direct sunlight. On the whole, dark green leaves are preferable to lighter or yellowish green ones. Abundant flowering, although in some varieties little is lost thereby, is generally disliked ; this will depend on the amount of pithiness of the parts below, but some material is used up in the formation of the flowers, and non-flowering canes have a longer growing period. Lastly, evenness of the clump is of great importance. This is greatly affected by the date at which tillering commences, but this is better judged in succeeding years. Unevenness of the thickness of individual canes is often noteworthy in first year's seedlings, but this tends to become less marked, when they are planted from sets. If the differences are very great, however, the seedlings are rejected.

Every seedling grown to maturity is ticketed with a number, and the year of crossing is marked by a letter. These are retained throughout the period of selection, and correspond with a register, giving details of parentage and treatment. When the selection for habit has been made, each plant is dug out whole and taken to the factory. Here, after the tops and waste leaves have been cleared away, a second selection is made, because the underground parts are now revealed and a better idea of the stand of canes can be obtained ; a great many rejections take place at this stage. Then the canes are cut off and divided into two parts, the upper third being kept for possible planting for the second year, and the lower two-thirds being passed through the sample mill. The cutting is done with a very sharp knife, in that the internal character of the cane can now be observed, especially as regards evenness of texture, hollows and pithiness, and general soundness. Then the juice is tested, but only as far as Brix and polariscope reading ; any attempt to judge the "rendement" would be futile, and this is left till much later. In judging the juice, the standard is again not fixed, but varies according to the general growth and seasonal conditions of the year. The factory results are then combined with those in the field, and a balance is struck for every seedling. As a general rule, although not universally, the handsomest seedlings produce the poorest juice.

The second year's selection.—The nursery in which the selected seedlings are planted is laid much as in the first year, with the difference, of course, that a number of plants of the same strain are now found together. The quantity of seed is limited, and the quality often poor, because of flowering, so that it is sometimes difficult to fill one furrow (one *roe* in length). If wide planting is resorted to, this must be allowed for in harvesting. Some two or three kinds generally stand out in the first year as particularly promising, though there are not usually more than five which can be so distinguished. The sets for the second year's nursery are called "élite bibit," and the few outstanding kinds are termed "maximalisten." Where possible, sets of the latter are also planted in another place purely for the purpose

classification is built up, is alone very great, and, if an attempt is made to enquire into the number of factors involved, it soon becomes evident that the chance of two entirely similar plants ever arising in the plots is extremely remote. Cytological studies show that the sugar cane is much more complicated in its inherent structure than other plants under cultivation. One result of this is that the raising of cane seedlings is peculiarly fascinating because, with a considered choice of parents, any individual seedling may turn out to be of great commercial value.

The first year's selection.—The criteria used are largely those included under the general term "habit," and the character of the juice becomes important at a much later stage. Most of the habit characters are observed in the plots before the canes are cut, namely in May or June. It is, however, important to remember that growth varies from year to year according to the character of the season; and thus there are no absolute standards, although, in general, certain lower limits are usually fixed. The object therefore is to be content at first with picking out the best that there are, rather than to compare the seedlings with the standard canes. There are very many characters which combine to form the habit of the cane plant, some of which can be easily specified and observed, while others cannot well be put down in writing. Of the former, some dozen or more are briefly considered by the author, and a few items are here extracted. For convenience, the word "batch" is used to indicate any collection of seedlings obtained from one crossing experiment.

Length of cane is of course important, and is fairly constant in any batch of seedlings; but the longest are preferred, other things being equal. If below a minimum, the whole batch is discarded. Distinction should be made between canes that have flowered and such as have not; the standard for the former is higher, because the part under the arrow is thinner and more or less pithy and devoid of juice, tending to lighter weight. Thickness must be taken together with tillering power, since a greater tonnage may be obtained from a thin, branching variety than a thick one with few canes. A minimum thickness is easy to fix, but a maximum is more difficult. As the result of many years' experience, however, very thick canes are regarded as liable to be inferior or spongy, and those of medium thickness are generally preferred. Very great tillering is usually combined with a number of undesirable characters. Further, a seedling in the first year sometimes tillers enormously, but when planted from sets loses this character, while in some seedlings the converse is the case. Therefore, seedlings with only two or three canes should not be rejected on this account alone. Certain batches show a marked tendency to the formation of water shoots, late canes of abnormal thickness. These should be rejected, unless a number of desirable characters are also present.

The form of the cane varies very greatly, but regular, upright ones are preferred, in that they are stronger and have more silica in their walls, to zigzag or crooked ones or those of varying thickness in different parts. Where flowering occurs, the upper part of the cane often becomes thinner, but in some kinds the average is well maintained to close under the arrow. Seedlings with slanting canes are avoided, because of the danger of lodging: with only moderate manuring, they should be erect. Long jointed canes are preferred, but too great length is a disadvantage, especially in thin canes, as the strongest part of the cane lies in the nodes. Straight-sided joints are the strongest and, of the rest, those which widen upwards are the weakest. Thick, swollen nodes are undesirable, and such canes as have many splits

The Raising of Seedling Canes in Java.

SELECTION.

In practising selection of seedlings, three things have to be considered: At which period of growth it should take place, what soil is best for the nursery, and what standard should be maintained; or, briefly, when, where and how to select.

When to select.—The earlier practice was to pick out the promising seedlings from the trays for potting. This, however, is now considered of little use, if not dangerous. Many growth characters have not as yet developed and, more important still, the vigour of such seedlings as those of Glagah, Kassoer and its descendants, is often associated with poor juice. Selection is now delayed till the last moment, when full growth has been attained, the best time being in May or June, after flowering. At the same time, it is of some assistance to make careful notes immediately before flowering, for then the canes in the field are covered with dead leaves, with fresh, green tufts above.

Where to select.—Light or good soil should be avoided, because here the growth conditions tend to the optimal. In porous soil, plants with weak root systems often show up as if they have strong roots; and in light soils the plants look handsomer than they would do in heavy. In good soil too, many plants would be selected which ought not, in that they would fail in poor soil; and the aim is rather to obtain seedling varieties which do well under as many different conditions as possible, some of these being poor. In a similar manner, but to a less extent, it is necessary to guard against mistakes from placing the nursery in heavy soil, for plants would be selected which, in better soil, might be pithy or might lodge. Nevertheless, the percentage of seedlings selected, which will make good, is usually greater when the nursery is on heavy soil than on light, probably because they possess a stronger root system. From which it may be concluded that land chosen for a nursery should be of an average character, if anything, tending to be on the poor side. Yet one other point should be kept in view, and that is the effect of natural selection in the nursery. Nature exercises little selection when the conditions of soil and climate are optimal, and many seedlings will then appear to be worth retaining. In somewhat adverse circumstance, nature itself acts much more decisively, and fewer mistakes are made because of this assistance.

How to select.—To maintain a high standard, it is necessary to keep down the numbers of seedlings at all stages, because of the very careful study required for a successful issue. Furthermore, with experience, new characters are constantly being added, on which to base the selections; and thus the percentages of rejections tend to increase. This is well shown in a statement of the annual percentages of seedlings passed at the end of the first year, during the period 1911 to 1925. For simplification, the five three-year averages have been calculated, and these are as follows: 13·06, 2·74, 1·40, 1·10, 0·54 per cent. From these figures, it will be obvious that the selection during the first year's growth has become very strict, and it is followed, as will be seen later, by even more rigorous selection in the second and third years. This explains why so few of the multitude of seedlings grown to maturity (392,871 from 1893 to 1925) have ever reached the stage of distribution to the planters, and, *pari passu*, the very great success which these have met with in the field.

One of the most striking characters among cane seedlings is the very great variation even among these derived from the same parentage. No two in fact are ever alike. But the number of visible differences, on which

bamboo sticks to divide it up. The fluff is evenly spread by hand in a thin layer and firmly pressed down, then lightly covered with earth to keep it in place. Every precaution must, in fact, be taken to prevent the light particles from blowing from one tray to another. For this purpose, the sowing is done under a special cover, and the whole tray is at first kept tightly closed with a wire and cotton frame. Watering, which helps to fix the fluff, is done with a very fine rose, and afterwards regularly twice a day. During the hottest part of the day (between 11 and 3) the trays are protected from the sun, but otherwise full sun and air are allowed. Rain is guarded against by special bamboo screens.

Germination.—This takes place early in Pasoeroean, usually on the afternoon of the third day ; and if, after 10 days, no seedlings have emerged, the tray is discarded, as there is then no prospect of germination. One crossing may give many more seedlings than another ; some yield 5-10 per tray, while others will furnish hundreds or even thousands. 100 POJ and 2883 POJ may be quoted as examples of varieties with few seedlings. Occasionally, patches of seedlings die away, through fungus attack. In such cases, the best plan is to remove the healthy sections to a fresh tray, taking care to avoid root injury by including clods of earth. Spraying with pyoctanin solution has been found effective for checking the attack.

Raising the seedlings.—The young plants of the sugar cane grow very quickly, and the root system is sufficiently developed in three to four weeks, for them to be planted in pots. A single arrow may produce several thousand seedlings, many of which may be of value, but it is obviously impossible to grow them all to maturity. It is usual to take 200 from one combination of parents, if there are several trays of one combination 150 of each, but with poor germination rarely over 100. The choice of parents is a dominating factor, and it has been found that, if the results of a cross are poor, a repetition rarely produces anything of value. In potting up, the seedlings are not selected in any way ; they are just taken casually, each if possible with a small clod of earth attached. The pots are about 5 ins. in diam. at the top, and are filled with the same soil mixture as the trays. They are well watered, and kept in a shed for a couple of days, after which they may be safely brought out into the full sun. As before, they are watered twice daily, and in about two months the seedlings will be about a foot high, sprouting will have commenced, and they are ready for planting out.

The nursery.—This is divided into plots, each of which is completely surrounded by a drain. The plots are long, and each is divided by a pathway down its length for inspection purposes, into two beds. Furrows are drawn across the beds, one *roe*[1] long and 3½ ft. apart ; there are about 70-100 furrows in the plot, and each furrow will contain seven seedlings. In planting, all of the earth in the plot is turned out, the roots binding it together ; this is placed in the furrow and plentifully watered. The roots, somewhat cramped by the pots, now grow rapidly, and the improvement in the seedlings during the first week is astonishing ; failures rarely occur at this stage. The plants are now subjected to ordinary field conditions, with the exception that only two-thirds of the usual dose of ammonium sulphate is administered. The object of this is to emphasize the differences in growth ; for a poor plant will respond to good manuring, and differences will be diminished. The whole period of growth, from the fertilization of the flower to the maturing seedling, is roughly about 14-15 months.

[1] *Roe* = about 4 yds.

in results, due to the absence of free air, and the greater temperature inside the cage. It is only used in Java where, for scientific reasons, it is imperative that foreign pollen should be excluded.

(3) *Living crossing* is the term applied to those canes in which both male and female arrows remain attached to their parent stems, the male arrow being bent to the appropriate position as regards the female. Both are firmly fixed, and the male requires some propping. The main advantage of the method lies in the saving of male arrows; but it requires the planting of the selected varieties close together, and there is always the chance that one or other may not flower. When it is convenient, two male arrows are used, for the greater protection from undesired pollination. It is only used on the station when, through accidental circumstances, it is desirable and possible; the method at present is less employed than any of the others.

(4) *Artificial crossing*. Collecting the pollen from the male plant, carrying it to the female, and applying it to the stigmas. Both male and female arrows are firmly fixed, and the pollen is collected between 6 and 7 a.m., when it is most freely produced. The method is as follows: The pollen is collected by placing a thin, shining, dark blue or black piece of cardboard under the male arrow; shaking the latter gently, and brushing the pollen to the middle; then folding the cardboard tightly and carrying it to the female arrow; here it is carefully brushed on to the part which is in flower. The female arrow appears to be unprotected in any way; but the danger of unwished for crossing is largely eliminated by only using the method at the end of the season, when arrows are scarce. The advantage lies in the fact that one male arrow can be made to serve for the pollination of a number of female.

Crossing must not be attempted at all times of the day. The flowers open shortly after sunrise, and the anthers a little later. During the early morning hours, the whole atmosphere is full of fresh floating pollen. Towards mid-day pollination diminishes, and by 3 or 4 o'clock has practically ceased. The male arrows are cut between 3 and 5 o'clock in the afternoon, and are at once placed in their bamboos, and arranged around the female arrow. The only exception is in artificial pollination, which must be done when the anthers are producing their maximum amount of pollen.

Ripening the seed and sowing.—As soon as all the flowers have opened in the female arrow, the males are withdrawn and thrown away. A cage is then placed over it to protect it from birds, and from the chance of the seed becoming mixed by the blowing about of parts of ripe arrows in neighbouring plants. Ripening takes from three to four weeks, longer in Malang than in the plains, and there are certain sure signs when it is completed. The smallest portions of the arrow begin to fall apart, and the small leaflet under it dries up. Then the arrow, which has all along been attached to the parent plant, is cut off short below the cage and carried to a sheltered spot to dry for a few days, fully exposed to sun and air, but carefully shielded from possible rain. When dry, the arrow readily breaks up, and its fluffy parts are collected in a beaker: they may, if desired, be sown without more ado.

Sowing is done in wooden trays whose bottoms are pierced with holes for drainage, 50 cm. long and broad, and 15 deep; and these are arranged many together upon bamboo racks, so as to be readily inspected and manipulated. The soil is a finely sifted mixture of fertile earth (zavelgrond, "tarapan"), sand, and cattle manure, in equal parts. For proper mixing all must be quite dry and finely divided, the manure being beaten with

later. This is a great bar to many desired crosses; but this difficulty has been largely overcome by transferring the crossing work to the Malang plateau, some 1200 to 1600 ft. higher, with better rainfall and lower temperature. Here the time of flowering in the different kinds shows a tendency to overlap, some kinds continuing to flower for 1½ to 2 months; while others which do not flower in the plains, such as Lahaina, Zwinga, Badila, Cayana, Uba, do so freely on the plateau. A great mass of data on this subject has been accumulated, which it is impossible to reproduce; but, in a Table, details concerning some of the less known forms are given; the amount of flowering, the part of the season, and the relative fertility of male and female organs.

Use as mother or father.—The species of Saccharum are usually bisexual, but in many kinds of sugar cane the pollen is more or less infertile. If this were not the case, crossing would only be possible by removing the stamens before pollination. This method has been explored sufficiently to show that it is either impracticable or that the results are entirely out of proportion to the amount of labour expended. The degree of male sterility in a given variety is, however, not constant, but is greatly influenced by the monsoon; and, even in the same season, there may be considerable differences. The method used at Pasoeroean for determining the viability of the pollen is still based upon the observation, made long ago, that fertile pollen grains have abundance of starch, while this substance is absent from the infertile ones. The iodine test for starch is therefore relied on. The percentage of fertile pollen is then gauged and, when this is lower than 40, the danger of foreign pollination is considered to be acute. In such circumstances, caging is thought to be necessary. The father and mother are chosen according to the amount of fertile pollen normally present—the mother little or none, the father an abundance.

Crossing.—Four different methods are employed at the station, and these may be briefly termed, free, cage, living, and artificial.

(1) *Free crossing* is by far the commonest at present, having to all intents and purposes completely replaced the formerly used cage. It consists in bringing the male arrows to the female daily, and placing them in such a position that the greatest amount of pollen shall fall directly upon the receptive stigmas. The female arrow is firmly fixed to a bamboo support, and the males are so placed that they completely surround the female, thus protecting the latter from the entry of any pollen from other plants. To ensure the freshness of the male arrows, they are cut with five or six joints attached, and placed in a bamboo filled with water, which is fixed to an upright stake. Flowering proceeds from the top of the arrow downwards, and the part of the arrow which flowers most profusely is from half to three-quarters down. The male arrows are cut when the flowers are open in this region, and they are placed so that these open flowers are just above the part of the female arrow which is then in flower. The time taken by an arrow for all the flowers to open is from six to seven days, although variations occur.

(2) *Crossing in cages.* These are, as usual, cylindrical, and consist of fine muslin tightly wound round a bamboo frame. They are hung up so as to enclose the female arrows, on a gallows-like support, and can be freely moved up and down. The male arrows are obtained and treated in exactly the same way as in free crossing. The cage method is condemned in Java, as requiring too much work for a large programme to be carried through in a limited time; and also because it is considered to be much less fruitful

the account in the *Archief*.[1] As, besides the language difficulty, this paper may not be available to many readers of this Journal, the following article has been prepared for the benefit of those who may be interested in this important subject. It will not be possible to treat of all the subjects discussed, for BANNIER's paper is very comprehensive, and extends roughly to 60 pages of illustrated letterpress and 80 pages of tables. It is divided into three sections : (1) Methods of raising and selecting seedlings, (2) The line of work and technique at Pasoeroean, and (3) The results obtained from 1893 to 1925. The first of these sections is dealt with in this number of the Journal.

FLOWERING AND CROSSING.

The crossing programme.—The raising of cane seedlings is an extremely easy matter, and it is a constant source of surprise, to those engaged in the work, that the idea ever crept in that the sugar cane was infertile. The author states that the methods employed have undergone little change during the past fifty years at Pasoeroean, although some minor simplifications and improvements have from time to time occurred. These methods were fully described in 1910 by WILLBRINK and LEDEBOER,[2] and they are unaltered at the present time. Greater and greater attention is, however, being given to the parents, and here the main difficulty is met with. Many workers have wondered why it has been so difficult to apply ordinary Mendelian principles to the sugar cane ; but it is increasingly evident that the make up of the raw material, the cultivated plant, is far more complicated than in most other cultivated forms. The sugar cane has, in fact, been subjected, during its long course of cultivation, to an extraordinary amount of hybridization.

Every year the parents to be used in the campaign are carefully discussed beforehand, with special reference to the needs of the industry. They are then studied afresh in every direction. The parents usually include both superior and inferior kinds, all of which are chosen for the transmission of some desired character. Selfing is no longer practised, as the almost universal result is a collection of types inferior to the parent. One especially important point to determine is which characters are usually passed on by a parent to its offspring ; and here the complex nature of the sugar cane is particularly discouraging. Some varieties have been found to pass on good qualities, and others not, while new good characters appear to arise from the chance meeting of hidden inherent factors. The method of crossing a plant with a great number of others to determine its make up, so often made use of, has been found to be largely inapplicable to the sugar cane.

The flower.—The first point to determine is which kinds will flower together. Canes about to flower can be easily picked out, by changes in the terminal shoot some time before anthesis, and four stages are described, from the first lengthening of the upper internodes to the bursting of the floral sheath. These stages are always noted on the cane varieties growing, and recorded for future use. The flowering season at Pasoeroean extends from the latter half of March to the end of May, but the exact time for any kind varies greatly in different places, and from year to year, owing to soil and climatic conditions, at present only partially understood. There is a constant tendency for Glagah (*Saccharum spontaneum*), and Kassoer and its descendants, to flower early ; while the better kinds are some three weeks

[1] De rietveredeling aan het suikerproefstation te Pasoeroean ; Techniek, Richting en Resultaten van 1893–1925. J. P. BANNIER. Mededeelingen van het proefstation, Jaargang 1926, No. 19.

[2] De geslachtelijke voortplanting bij het suikerriet. *Archief*, 1911, I, p. 367.

come mainly from the cities and towns of the Old Country and their gregarious habit survives out here. They remain quite contentedly within the radius of the high lights and bright lights of each State metropolis. The already overgrown city extends its outer suburbs still further into country that has altered little comparatively since Captain Cook sailed his leaky ark along the eastern coast.

The remedy—and there is a remedy—for all this is fairly plain. It is active, vigorous and systematic decentralization. Queensland as a result of wise statesmanship in earlier days is comparatively free; anyhow it is not affected so badly from the "One Big City" evil. Along its whole littoral are thriving seaports growing rapidly into important cities, each serving and drawing tribute from a province as large and as rich as the State of Victoria; each with either a developed or undeveloped coalfield at its back gate—a gilt-edged security for a bright industrial future; and each destined to become when wisdom prevails in our legislative halls, the capital city of a new and wealthy State. In all this the Queensland sugar industry is proving a valuable developmental, and remarkably progressive factor—a factor which it was fairly evident that our distinguished visitors from the Mother of Parliaments were not slow to recognise, nor were they lacking in their appreciation of it.

The Raising of Seedling Canes in Java.

When the fertility of the seed of the sugar cane was finally demonstrated and generally accepted, a good deal of attention was devoted to it in Java, but it was regarded rather as an interesting scientific fact than as of immediate practical use. But this study proved to be of the utmost importance when, shortly afterwards, the industry was threatened by the disastrous outbreak of sereh disease in the cane fields. It was an easy matter to concentrate attention on the raising of seedlings, for the purpose of obtaining new varieties which were resistant or immune to this disease. This work was carried out on the experimental station at Pasoeroean, and the immediate results are known to all. Seedling work, although varying in its prominence at different periods, has been continued ever since; as it was recognized once for all, that it was a legitimate and fertile means for improving the character of the canes being grown. Although often receiving little attention from the outside world, the botanists of Java have gone on steadily with the work to the present day, always with the idea of obtaining better and yet better varieties for the local conditions. Java seedlings have spread over every part of the world, those already waning in their popularity in Java being often used elsewhere with advantage. These facts make it important that more should be known about the methods employed, the raison d'être of the various seedlings sent out, and especially the lines of development in the Java work. This work, controlled as it is by the planters, is of course eminently practical, but nowhere else is it based on such careful preliminary scientific study. Whether relying on the fact that the local conditions are entirely peculiar, or influenced by the little known language in which the results were from time to time published, comparatively little is really known of the inner details of the Java work, and the difficulties which have been met and surmounted.

The colossal task of writing up the plan and results of each year's work from the start has now been successfully accomplished by J. P. BANNIER, a plant expert attached to the Pasoeroean station, and he has published

and the Commonwealth asserted quite confidently that Australian sugar was sold in our sister Dominion at £11 per ton. As a matter of fact the quantity of Australian sugar sold in New Zealand is quite negligible, for New Zealand obtains almost all of its sugar from Fiji where it is produced by coloured labour. Raw sugar may be imported into the Dominion free of duty as there is no sugar industry there to protect. Why a visitor of importance was permitted to make comparisons publicly which were based on absolutely wrong information without being put right, and without being informed of the difference, from our point of view, between white and black grown sugar, passes comprehension.

"Is it worth while," our visitor asked, "to keep on producing a crop which has to receive Government assistance?" He should have been informed that the price paid by the Commonwealth consumer covers fair and reasonable production costs under white labour conditions. The Government does not assist the industry in the sense implied. The price paid for sugar in Australia is largely the price of White Australia and the home consumer knows and accepts that fact cheerfully. Australia standing for an all-white population (98 per cent. at least, of its present inhabitants are British in origin and sentiment) is prepared to pay for racial purity and racial preservation.

The earnings of cane-cutters astonished some of the touring Parliamentarians who regarded the wages paid as altogether uneconomic. Canecutters in Queensland are paid by results and good value is received for the money. The industry in Australia is called upon continually to combat ill-informed and un-informed criticism—criticism that, were the politics and economics of the industry understood sufficiently, would not be uttered.

MIGRATION.

Obvious objectives of the Imperial Parliamentary Delegation were to observe, at first view, Australia's resources and to obtain a knowledge of local conditions that would assist in a solution of the Empire's migration problem.

It is accepted, *a priori*, that this continent is in urgent need of a much greater population than it already possesses; that the countries from which we may attract migrants, if we are to keep Australia white must be Europe and the United States of America (omitting of course, other British Dominions who have the same need, though, with the exception of South Africa, not so urgent, for white population as we have); that we should obtain most of our immigrants, if possible, from the Motherland.

As soon as a practicable system of migration is considered difficulties arise. To start with, the existing distribution of Australian population must be noted. A flying survey reveals the fact that most of our population is gathered in the south-eastern corner of the continent, with some extension up the eastern coast. Outside that region our population is very sparse and scattered. Geographical and meteorological conditions are responsible primarily for this, and added to them is the irresistible magnetism of the big cities, the huge State capitals—Sydney, Melbourne, Adelaide and Brisbane—within this area. They are all ports and centres of railway administration and control consequently the transport system of each State to the tremendous advantage of the over-crowded capital and the serious detriment of country interests. They are the centres of political, commercial and industrial influences and by sheer weight of numbers control the Parliamentary machine in each State. The harmful political and economical effects of this unnatural concentration of population are quite obvious; and then arises the problem of migrant absorption—a problem accentuated by the fact that, from our present experience of new arrivals, migrants

The Application of Electric Motors to the Driving of Centrifugal Machines.[1]

The problem of the best method to use in arranging to drive a centrifugal machine by means of an electric motor is one of considerable interest to sugar manufacturers and refiners and other users of such machines.

The centrifugal machine, from a power engineer's point of view, is essentially a flywheel, which must be started up from rest at frequent intervals, run at its normal full speed for a short period, and then be stopped, this process being repeated indefinitely. Like other flywheels, by far the greater amount of power is required, during the acceleration period, in overcoming the inertia of the basket and load, and it is this fact which constitutes the principal problem in applying electric motors to drive such machines. The electric motor, when supplied from a constant potential system (which type of supply is almost universally used), is essentially a constant speed machine, no constant potential motor being capable of continuous variation in speed from zero speed up to full speed, except at the expense of power wasted in resistances. It is true that speed variations without loss may be obtained in constant potential motors by means of shunt regulation in D.C. machines, and by means of pole-changing devices in A.C. machines, but such speed variations take place between a high speed and a still higher one and not from zero speed.

It follows, therefore, that if a constant potential motor is used to drive a centrifugal machine, some form of power-wasting device must be inserted, either between the motor and the centrifugal or in one of the motor circuits. The characteristic of all such devices is, that an amount of energy equal to the energy stored up by the basket and load will be wasted, and appears somewhere in the form of heat. That is to say, of the total energy supplied by the motor, after deducting a certain small amount absorbed by windage and friction of the centrifugal, the remainder is divided into two equal parts, one of which goes into the centrifugal basket and load as useful work in overcoming the inertia, and the other of which is wasted. As will be shown later, a certain amount of power may be saved if the motor is arranged to give the whole speed increase in two (or more) steps, such as by means of pole-changing arrangements in A.C. motors. The following are some of the more common methods of dealing with the problem.

(*a*) *Friction clutch drive.*—In this method a friction clutch is interposed between the motor and the centrifugal, and when the motor is started it runs immediately up to the full speed corresponding to the load, allowing the friction clutch to drag the centrifugal up to speed behind it. The necessary loss of power takes place in the friction pulley, which must be designed of ample size to get rid of the heat developed. The friction clutch method is applicable to shunt and compound wound D.C. motors and to polyphase induction motors. Since the power lost in the friction pulley depends on the speed to which the centrifugal must be raised before the friction blocks stop slipping, it follows that a certain gain in this respect may be had in the case of a D.C. motor, by making it compound or series wound, and arranging the saturation of the field magnets such that a considerable drop of motor

[1] This paper is reproduced by permission from a pamphlet prepared and issued by Messrs Pott, Cassels & Williamson, of Motherwell, Scotland (a firm who have had a lifelong experience in the manufacture of centrifugal machines) to give all those interested the benefit of their experience in electric drive systems. It should be added that the electric motors supplied by this firm for their centrifugals are made by a well known firm of electrical engineers, the Macfarlane Engineering Co Ltd, of Cathcart, Glasgow, who have long been associated with Pott, Cassels & Williamson in devising suitable electric drives to give the highest efficiency in centrifugal operation. For further details on constructional points in the machines referred to in this paper, the reader should apply to Messrs. Pott, Cassels & Williamson for List No. 89.

speed occurs. If the motor speed drops to say 75 per cent. of the normal full centrifugal speed when developing its full torque, the actual energy lost will be 56 per cent. only of what it would be if no drop in motor speed took place. This saving cannot be attained in A.C. machines, where the energy lost is determined by the synchronous speed (that is, the speed of the revolving field), which has a fixed value. The friction clutch drive possesses the *advantage* of cheapness in first cost, as the motor need not be any larger than will give the maximum power required, viz. : Net accelerating power, plus friction clutch loss, plus centrifugal windage and friction loss. It is also simple and easily understood by the engineer in charge. It possesses the following *disadvantages*, viz. : Wear and tear of friction blocks and pulley add to the running cost. There is a risk of the motor being overloaded either through the friction blocks being increased in weight, or through dirt (sugar dust, etc.) getting into the friction pulley and so increasing the coefficient of friction. In any case, the coefficient of friction (with any of the ordinary friction linings) varies somewhat with the humidity of the atmosphere and with the temperature of the friction pulley, thereby leading to irregular acceleration.

(*b*) *Direct coupled motor.*—As at present applied, direct coupling of the motor to the centrifugal is used only with A.C. motors. It is possible to directly couple a D.C. motor to a centrifugal and switch it right on the line, but such an arrangement is of comparatively little interest. It is also possible to couple an A.C. slip ring motor directly to the centrifugal spindle and use automatic gear to cut out a resistance inserted in the rotor circuit, but this method is complicated and clumsy. The method employed with A.C. motors is to use a squirrel cage machine with a comparatively high resistance rotor. This rotor and its winding are designed to be of a size and capacity suitable for dissipating the heat generated in it during the acceleration period. This heat is equal in amount to the heat generated in the friction pulley in a friction clutch drive, but can be got rid of much more easily on account of the better ventilation of the squirrel cage rotor. In this case the same total power is drawn from the line and consists of : Net accelerating power, plus loss in the rotor windings, plus centrifugal windage and friction loss. Instead of this total power appearing at the *shaft* as in the case of the friction drive, it appears at the *air gap of the motor*.

The principal *disadvantage* of the direct coupled motor is the higher initial cost, because, of course, the rotor has to combine the ordinary duty of a rotor in an induction motor with that of a power wasting resistance, and as the motor must get rid of the heat which would otherwise, in the case of the friction clutch drive, be developed in the friction pulley, the machine must be larger than a motor designed to operate through a friction clutch. The *advantages* are principally in running cost : There are no friction blocks or pulley to wear out, the connexion between motor and centrifugal being by means of a flexible coupling having sufficient flexibility to allow the centrifugal to " wobble " as much as is necessary. There is no possibility of overloading the motor. There is a corresponding reduction in the amount of skilled labour required about the machine.

(*c*) *Pole changing 2-speed drive.*—Where it is intended to install direct coupled induction motors to drive a battery of centrifugals, it costs comparatively little extra to have these wound as 2-speed machines. If the normal speed of the centrifugal is 750 r.p.m. for instance, by a simple pole changing device the machine can be run at 750 r.p.m. or 375 r.p.m. at will. This provision of a lower speed is

of considerable advantage in charging, and in keeping the speed down to a reasonable limit, where ploughs are used for discharging the basket, In using a 2-speed machine, the current is switched on to the lower speed winding first, and the basket is charged at this lower speed. By the time charging is complete, the basket will probably have reached half speed and the higher speed winding is then switched on, bringing the basket up to full speed and completing the drying of the contents of the basket. One of the special advantages of the 2-speed machine is that charging can be done at a comparatively low speed, by which means the bulk of the molasses, or mother liquor, is thrown off at low speed, leaving only the final residue to be driven off at full speed. This is of special importance where the liquid portion of the charge is large compared with the solid part (as in the case of certain chemicals), since the power absorbed in driving off the liquor at high speed is very considerable ; also, where the material is free drying, there is the further difficulty in charging at high speed, that the liquor is driven off immediately the material to be dried enters the basket, and this leads to irregular loading and bad balancing of the basket. Apart from these considerations, however, there is the fact that half of the energy normally lost during acceleration in a single-speed drive (whether friction-coupled or direct-coupled) is saved in the 2-speed drive, *provided* that the machine is started on the low-speed winding and allowed to accelerate to half normal speed before switching on to the full-speed winding. If this condition is observed, the 2-speed machine can be made as small as the single-speed direct-coupled machine. It must be noted. however, that the centrifugal must be allowed to attain half speed before switching on to the high-speed winding, otherwise the higher losses due to single speed working will be approached.

Owing to the fact that the friction blocks of a friction clutch must be made heavy enough to transmit the torque at the lower speed, there is no advantage in size to be gained by inserting a friction clutch in a 2-speed drive, and therefore such motors are usually directly coupled to the centrifugal. 2-speed induction motors are made with one stator winding, which can be so connected as to give alternatively two sets of pole connexions, one of which has twice the number of poles (and therefore half the speed) of the other. The change over is carried out by means of a simple form of 6-way change over switch. This 2-to-1 ratio is the only one which enables the stator copper to be fully utilized. If any other pole ratio (such as 3-1) is adopted, then, generally speaking, two separate stator windings are necessary and the motor must be considerably larger, as only about 50 per cent. of the stator copper is in use at any one time. Further, the advantage in the way of saving of power, described above, is not so great. Nevertheless, where ploughs are used, half speed, even allowing for the greater proportionate slip on the lower speed, may be considered in some cases too high for the satisfactory operation of ploughs ; although it is a comparatively easy matter to keep the machine down to any speed desired by means of the switch and brake.

Where ploughing is a matter of importance, and it is desired to drive the centrifugal at very low speeds (with an induction motor), the low frequency method has special advantages.

(*d*) *Low frequency supply.*—This method consists in supplying the motor with two separate current supplies, one of normal frequency and the other of very low frequency, supplied from a special alternator. A special selector switch allows either circuit to be chosen at will. In operation

the centrifugal is started up, and charged if necessary, on the lower frequency and is then run up to full speed on the higher frequency. When ready to discharge, the high frequency is switched off, and the centrifugal reduced in speed (by means of the brake) to a speed approximately corresponding to that of the lower frequency. The lower frequency is then switched on and the centrifugal runs at a speed suitable for ploughing. A certain amount of power saving (over the simple single-speed machine) is possible here also, although as the low speed is generally arranged to be considerably less than half speed, the proportionate saving is less. This is more than balanced by the greater advantage of this type of machine where ploughs are used.

(e) *Variable voltage motors.*—Induction motors are sometimes supplied, in which a variable rate of acceleration is obtained by altering the voltage of supply to the stator winding by means of an auto-transformer or some other equivalent device. The advantage of this system is that a lower rate of acceleration is obtainable by lowering the voltage of supply to the stator. There is also a very slight saving in power at *full speed* owing to the reduced iron losses and a somewhat improved power factor when running at full speed on low voltage. This latter saving, however, is small, because not only is the power absorbed by the centrifugal at full speed small, but under modern conditions running at full speed occupies only a small proportion of the total time for a charge. The disadvantages of this system are the greater cost of the installation with auto transformers, selector switches, etc. Some makers supply one auto-transformer only for a group of centrifugals, but this has the disadvantage that if one machine is operating on low voltage, all the others of the group must similarly operate on the same voltage.

Machines can be supplied in which the advantages of a lower voltage supply are obtained without the use of auto-transformers. The motors are simply wound so that the stator windings can be coupled " mesh " for high torques and " star " for low torques, thus giving the effect of two voltages, the lower of which is 0·58 of the normal voltage. A simple throw-over switch can be used to select the connection required, and without disturbing the action of other machines of the group.

The above remarks have been confined largely to induction motors because a 3-phase supply is almost universally used in sugar factories and refineries. Where direct current is used, friction clutches are usually interposed between the centrifugal and the motor. It is possible, however, to use direct-current motors of a type which can be direct-coupled to the centrifugal and can be arranged to give *any* lower speed at will without loss. Further, such machines can be arranged to give a regenerative braking torque, but it is doubtful whether the extra complication, together with the fact that the machines must have commutators, would appeal to the user in view of the great simplicity and robustness of the A.C. squirrel cage motor.

Incidentally, in connexion with the use of A.C. motors driving centrifugals through friction clutches, it has been stated by certain makers of such motors that as their machines are of the so-called " high torque " type, they are necessarily much more efficient, when used for centrifugals, than are motors of ordinary design. It must be apparent to all who consider the question carefully that " high torque " motors are not of any advantage where machines are to be driven through friction clutches, because such motors run during acceleration at something near their normal full speed and give approximately their normal full load. The torque which they have to develop, therefore, is full load torque, and they will do this

whether the machine is of the so-called "high torque" type or otherwise, there being no difference in their performance in this respect, except that the high torque motor may possibly have a slightly greater slip than the other. Where motors are directly coupled to the centrifugals, however, they are necessarily of the high torque type, the design being such that the maximum torque of the motor is developed at slightly over zero speed.

It has been objected that the initial starting current of direct-coupled motors is higher than that of motors designed to drive through a friction clutch, but this is not the case. The direct-coupled motor has usually a lower short circuit current than the friction coupled motor, but in the case of the direct-coupled machine the initial current lasts long enough to be read on an ammeter, whereas in the case of the friction coupled motor the initial current is higher, but is more of the nature of a "kick," lasting such a short time that a dead beat ammeter will not respond, although the effect of the "kick" may be seen on any lamps connected to the same circuit.

Summary.—The foregoing remarks are intended to convey some idea of the relative merits of various methods of coupling up centrifugal machines to their driving motors. Bearing in mind the varied requirements of the modern sugar factory, it may be claimed that the method best adapted to meet these requirements (in the majority of cases) is to provide a motor suitable for direct coupling to the centrifugal and having a 2-speed winding (ratio 2-1) which enables it to be used to the best advantage for charging at low speeds and for discharging by means of ploughs. Such motors can be wound and connected so as to give an increased torque for ploughing on the low speed, and on the high speed a reduced current and improved power factor; while the average power required in a group of such machines will be decidedly less than in the case of a plain friction-coupled or a direct-coupled single-speed machine.

Publications Received.

Hydrogen-ion Concentration. Leonor Michaelis. Volume I: Principles of the Theory. Translation from the Second German Edition by Wm. A. Perlzweig, M.A., Ph.D. (Baillière, Tindall & Cox., London.) 1926. Price: 22s. 6d.

Dr. Michaelis' classic work, *Die Wasserstoffionen Konzentration*, was published in 1924, the first comprehensive text on the subject. But this book before us is more than the usual "second edition." The broadened realm of pure physical chemistry and the extraordinary growth and multiplicity of the applications of this branch of science have made necessary a thorough recasting, so that an entirely new treatise results, the most extensive so far attempted, the old work being expanded to three volumes. It is the first of these three volumes which is now announced. It presents the theoretical physico-chemical principles on which the colorimetric and electrometric methods of measuring hydrogen-ion are based, and does it more thoroughly and more broadly than has hitherto been attempted. The wealth of information contained in the volume will be serviceable not only to those who are engaged in the theory of practice of determination, but also to all those investigators and students who realize the great importance of physico-chemical phenomena in all life processes. The fundamental principles of theory are placed on a wider basis than has hitherto been possible; and the student of the problem of the clarification of sugar juices and of the growth of the plant will be well repaid by its careful perusal.

Inoculation of Legumes and Non-Legumes with Nitrogen-fixing and other Bacteria. F. Löhnis and L. T. Leonard. U.S. Department of Agriculture, Farmers' Bulletin, No. 1496.

By the cultivation of legumes large quantities of nitrogen can be obtained from the air, but for all cultivated non-legumes the nitrogen present in the soil alone is avilable. Nitrogen fixation from the air takes place only if the legumes harbour the proper bacteria in their root nodules. Legumes without well-developed root nodules as a rule do not attain a fully satisfactory development. Artificial inoculation with their specific bacteria is advisable in such cases ; but proper tillage, together with the application of lime, phosphate, and potash, deserves equal attention. For the inoculation of legumes, soil can be used, if it contains the proper bacteria and is free from weed seeds and plant diseases and parasites; or artificial cultures may be obtained from Government of State institutions or from reliable firms. The inoculation of non-legumes as well as of the soil itself with various beneficial bacteria has been tried repeatedly, but without success.

Science for All. Sir Arthur E. Shipley, G.B.E., Sc.D., F.R.S., and others. (Ward Lock & Co., Ltd., London.) 1926. Price : 6s. nett.

This is a book on what can hardly be called "popular science." It is a series of outlines, not "written down" for the accommodation of the general reader, but terse, lucid and most highly interesting summaries of our present dav knowledge of the leading branches of science by leaders in their respective branches. Sir CHARLES S. SHERRINGTON has written the introduction ; Dr. A. C. D. CROMMELIN, D.Sc., F.R.A.S., deals with "Astronomy; Dr. DAVID OWEN, D.Sc., with "Physics"; Dr. HERBERT H. THOMAS, D.Sc., with "Geology"; Prof. J. MONTAGU DRUMMOND, M.A., F.L.S., with "Botany"; Sir ARTHUR E. SHIPLEY, LL.D., F.R.S., with "Zoology;'; Dr. SWALE VINCENT, M.D., F.R.S.E., with "Human Physiology" and Prof. J. R. AINSWORTH-DAVIS, M.A., M.Sc., with "The Story of Man." These pages unfold wonderful stories, not less enthralling than anything in fiction.

The Chemistry of Wood. L. F. Hawley and L. E. Wise. Monograph Series, American Chemical Society. (The Chemical Catalog Co., Inc., New York.) 1926. Price : $6·00.

These authors, the latter of whom is Professor of Forest Chemistry at the N.Y. State College of Forestry, at Syracuse University, review in this book the literature relating to the chemical components of wood, the proximate and summative analyses of wood, the decomposition of wood, and wood as an industrial material. It should serve as a useful work of reference to chemists such as may be concerned with the utilization of bagasse, or the production of alcohol by the hydrolysis of cellulosic materials.

Resistance in Sugar Beets to Curly Top. Eubanks Carsner. U.S. Department of Agriculture, Department Circular, No. 388.

Evidence reported here established the fact that there are definite variations among individual sugar beets in regard to susceptibility and resistance to curly-top, and justifies the hope that a variety of beets may be developed satisfactorily resistant to the disease.

Starch Making and the Manufacture of Dextrine, Starch Sugar, Syrup, and Sugar Colouring. Felix Rehwald. (Scott, Greenwood & Son, London.) 1926. Price : 12s. 6d.

This treatise, here translated from the fifth German edition, is a record of Continental practice in the making of starch, dextrin, caramel, etc. It can be recommended for the general survey which it gives of the subject.

Brevities.

A calculating disc for calculating the purity value given sucrose and the density is described by E. SAILLARD.[1] It is sold by the well-known firm of seed growers, Vilmorin, and costs about 400 francs.

A hydrometer, provided not only with a thermometer, but also with a temperature correction scale inside the spindle, has been invented by JAS. B. PETTIT. It is applied to a Brix instrument, and corrected readings can be instantly read.

The Guild trichromatic colorimeter[2] is now being made in London. It enables the colour of any object to be measured and specified accurately and reproduced at any time. Variations in colours are represented by its means as definite numerical differences from a standard measurement. It is simple in use, enabling determinations to be carried out by untrained assistants.

According to HUMBERT's Sugar Report, the German 1926 surplus sugar production was disposed of more quickly than anticipated; in fact, the whole of the 6 per cent. allowed to be exported by the end of this month was sold by October. The amount was approximately 100,000 tons, of which about 50,000 tons of raws went to Sweden, Holland and Switzerland, the remainder in refined going to various destinations, of which India got the bulk.

Last year the record amount of 298,960,000 gallons of molasses were imported from Cuba into U.S.A., equivalent to an increase of 48 per cent. over 1924, and of 627 per cent. over 1913; 3,845,000 gallons of molasses were shipped from the United Kingdom to America in 1925. The amount of the molasses consumed in the manufacture of industrial alcohol during the fiscal year 1925-26 also set a new record, amounting to 267,404,218 gallons, compared with 203,270,135 gallons in 1924-25.

The Pure River Society, with the Duke of Rutland as President, has been formed. It has already requested the Minister of Agriculture and Fisheries and the Minister of Health to receive a deputation relative to the appointment of a Central Water Authority (as recommended by the Royal Commission on Sewage) to deal with the prevention of river and sea pollution and the abstraction of water from streams. One of the most important intentions of the Society is the formation of a central fund to enable land-owners to take their cases to court when more conciliatory methods fail. It is further announced that the Minister has called a conference to discuss remedies, to which representatives of the beet factories have been invited to be present.

It is annnounced that the Association of Special Libraries and Information Bureaux has been incorporated, and that "the new body will act as a channel through which any enquiring member may be put into direct touch with the source of information desired." A directory of sources of specialized information in the British Isles is in course of preparation, a copy of which will be forwarded to each member when available. It is hoped also to establish by co-operation between interested parties unified policies with respect to abstracting, cataloguing, indexing, filing, etc. Membership subscription has been fixed at Two Guineas. To ensure the establishment on an adequate basis, not less than 500 members are required by March, 1927. The address of the Association is 38, Bloomsbury Square, London, W.C. 1.

Mr. CARLOS L. LOCSIN[3] gives the cost of cane production for seven *haciendas* in Northern Occidontal Negros, P.I., operating during 1924-25, these averaging (in Philippine dollars) as follows for the cost per hectare: Total labour cost, 264·26 (made up of preparation, planting, replanting cultivation, ditching and fertilizing, 89·2; harvesting, 87·16; administration, 40·50; supervision, 26·32; care of animals, 10·80; and repair of buildings, implements, etc., 10·28); total operation cost, 102·99 (made up of rent of *hacienda*, 14·04; fertilizer, 71·48; miscellaneous expenses, 8·81; and Planters' Association, 8·66); and depreciation costs, 48·88 (made up of depreciation of animals and equipment, 20·28; interest, 25·33; and bad debts, 3·27). This gives a total production cost of 416·13 per hectare, and the piculs of cane per hectare averaged 109·68, this giving a total overall cost per picul of 3·79 Philippine dollars.

[1] *Suppl. Circ. hebd.*, No. 1949. [2] *I.S.J.*, 1926, 325 331. [3] *Sugar News*, 1926, 7, No. 9, 625-631.

When potatoes are dried, sugar (sucrose) is formed in amounts up to about 5 per cent. Prof. Dr. E. O. VON LIPPMANN points out that this is probably due to the reduction of the starch to dextrose and levulose, which mixture is later converted to the disaccharide sucrose.

A small "hand polariscope" was recently described[1] having a range of —20 to +20° circular degrees, said to be of use for testing the sugar content of beets. For such purposes a tube 94·7 mm. long reads so that 1 degree corresponds to 1 per cent. of sucrose. A lamp is not required.

Dr. BARTENS[2] recently published a study of the position of cane and beet sugar production, giving *inter alia* the sugar production in all countries of the world during the past 25 years, and a table stating sugar consumption,, population, and consumption per capita, also for all countries of the world. Some of the per capita figures for 1924-25 are as follows: Germany, 49·3; United Kingdom, 86·9 lbs.; Denmark, 93·7; U.S.A., 119·2; Australia, 111·7; and Hawaii, 176.

In November, 1926, Mr. E. SAILLARD,[3] Director of the Laboratory, of the Comité Central des Fabricants de Sucre de France, received three large beetroots, the weight, sugar content and district grown of which were as follows: (1) 10 lbs. 8 ozs., 12·30 per cent., Villeron (Seine-et-Oise); (2) 9 lbs. 10 ozs., 13·7 per cent., Saint-Leu-d'Esserent (Oise); and (3) 9 lbs. 2 ozs., 10·4 per cent., Rue (Somme). But these figures are far below those stated to have been obtained in Colorado, namely, 35 lbs. 2 ozs. and 15 per cent. of sugar.

That beet pulp has a destructive effect on both concrete and mortar is shown by O. V. ADAMS in a bulletin recently published.[4] This desintegrating influence is not great up to 150 days of contact, but increases progressively after that time, and is much accelerated by frost. A concrete roadway leading to the Loveland beet factory, Colorado, gradually became rutted, until after a few years it fell into very bad condition. This was concluded to be due to the combined effects of the beet pulp, of frost, and of traffic.

A type of lime hydrator much favoured in chemical works in the United Kingdom, which would appear to be highly suitable for sugar factory and refinery work, is that made according to the patent of Schulthess, a Swiss inventor. Slaking proceeds automatically and rapidly; loss of lime dust is entirely prevented; no breaking up of material is necessary; manual labour is limited to feeding in caustic lime, though, if desired, this can be done mechanically in the case of large units; motive power is very small; and a dry product can be obtained of high purity and capable of being kept for an almost unlimited time.

Among new companies recently registered are the following :—Société Anonyme des Anciens Etablissements Gaetan Brun., Edwardes Square, Kensington, W. 8. Incorporated in France; to distil beetroots, grains, fruits, molasses and other products capable of being fermented; to produce yeast and alcohol, etc. Nominal capital, 6,300,000 francs in 12,600 shares of 500 francs each. Person authorised to accept service: C. E. R. Monsarrat, 11, New Court, Lincolns Inn, London, W.C.2. Selby Sugar Co., Ltd., 8, Frederick's Place, Old Jewry, E.C.2. (Registered No. 217,970).—Private. Nominal capital, £1000 in £1 shares.

Prof. ARTHUR R. LING (of the University of Birmingham) in an address delivered before the Birmingham and Midlands Section of the Institute of Chemistry on "Chemistry as a Career" made the following remarks: "The sugar industry, which was now established in this country, offered positions which might be regarded as stepping stones to positions concerned with research and factory control and management. A knowledge of physical, inorganic and organic chemistry as well as of the subsidiary subjects of engineering, agriculture and bacteriology, was required. The sugar factory was so much concerned with engineering, that that subject might almost be regarded as of primary importance, and students who intended taking up the manufacture of sugar as their career, certainly require more training in engineering than those attached to most other branches of manufacture."

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[1] *Chemiker Zeitung*, 1926, 50, 774-775. [2] *Die deutsche Zuckerindustrie*, 1926, 51, 539-544.
[3] *Circulaire hebdomadaire*, 1926, No. 1967.
[4] Bulletin No. 306, Colorado Experiment Station, Fort Collins, U.S.A.

Review of Current Technical Literature.[1]

REPORT OF THE CHIEF OF THE BUREAU OF CHEMISTRY (SUGAR AND SUGAR INVESTIGATIONS). **C. A. Browne.** *Published by the U.S. Department of Agriculture, Washington, September 1st, 1926.*

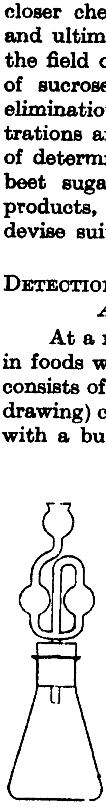
"Progress was made in the work on a method for producing unsulphured cane syrup of good quality from low-purity cane juice. This procedure will permit heavy milling and greater extraction of juice in the manufacture of this type of cane syrup and reduce the loss resulting from low juice extraction. When used in conjunction with sugar production, it will be possible to use the higher-purity juice for sugar, the lower-purity juice, representing higher extraction, being used for making syrup. This will make for greater economy in the commercial utilization of sugar cane under domestic conditions. As a part of this investigation a method for producing a new article called "cane cream" has been devised, the production of which on a semi-factory scale will be undertaken during the season of 1926. Cane cream, which is also made from the lower-purity juice, has a consistency similar to that of confectionery fondant and a characteristic cane flavour. It can be made of widely varying consistency, and can be used for many purposes, for instance, in sandwiches, on griddle cakes, and in the preparation of cake icing. The cost of manufacture is moderate, and the use of lower-purity juices for producing cane syrup and cane cream will make possible greater efficiency and economy in the manufacture of sugar from higher-purity juices when used in conjunction with it. The fabrication of these products is part of a general plan for the production of specialities which, is believed to be of great economic importance to the Louisiana sugar industry. Progress was made in an investigation of the fundamental conditions governing the clarification of cane juice in the production of raw and plantation granulated sugar.[2] Because of the lack of a full understanding of the various factors which control clarification of juice, the elimination of non-sugar substances fron juice in sugar manufacture is conducted with a varying degree of efficiency, and the maximum clarification possible is far from being consistently attained. Methods are being devised whereby the juice can be tested from time to time and suitable adjustment made in clarification conditions so as to obtain uniformly the maximum efficiency possible with the clarification process used. This work is being conducted in conjunction with the development of means for controlling the addition of lime to cane juice automatically by means of a potentiometer, which also continuously records the pH values. The pH value maintained by the potentiometer control can be readily changed from time to time, as the condition and type of the juice may demand. A method of selective fermentation has been devised whereby the invert sugar of cane molasses may be transformed into alcohol without fermenting sucrose. This makes possible the application of methods for the de-sugarization of cane blackstrap molasses and at the same time affords a profitable utilization of the invert sugar present, which would otherwise not only be wasted but would also interfere with the recovery of sucrose. A public service patent covering this process has been issued.[3] Information of much value has been obtained in an investigation of the fundamental conditions governing the action of decolorizing carbons, including bonechar,[4] in removing colloidal substances present originally in cane and beet juices and also produced as a result of decomposition reactions during the course of sugar manufacture. This investigation throws much light on the particular types of colloidal substances that are best removed by decolorizing carbons and those that could be eliminated most profitably at an earlier stage in the clarification of the juice. Tests have been devised which show the types and quantities of colloidal substances present at each stage in the sugar process, so that exact control can be exercised.[5] The data obtained also suggest means for the more efficient use of decolorizing carbons. A method has been worked out whereby the clarification of acid digestion liquors in the manufacture of glucose and corn sugar may be greatly improved. This is of much importance in view of the fact that uneliminated colloidal sub-

[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.* [2] *I.S.J.*, 1926, 608. [3] U.S Patents, 1,572,359; *I.S.J.*, 1926, 448. [4] *I.S.J.*, 1926, 609. [5] *I.S.J.*, 1926, 23, 97, 137, 497.

stances interfere with the growth of corn-sugar crystals. If the crystals are too small, difficulty is experienced in separating them from the mother-liquor by centrifuging. A systematic investigation has been made of the carbohydrate constituents of a number of plants about which insufficient information was available. This work is designed to yield fundamental information on the basis of which new uses may be found for plants now cultivated or capable of cultivation and by-products of existing processes of utilization may be used more profitably. An investigation of the variation in viscosity of beet molasses in relation to its retarding effect on the crystallization of low-purity massecuites was practically completed. Viscosity measurements were made after adjusting the molasses samples to constant sucrose-water ratio, constant sucrose-raffinose-water ratio, etc., and the influence of different constituents and groups of constituents on the viscosity of molasses was indirectly determined. The data were also examined from the standpoint of their relation to the discarding of molasses in the Steffen process for desugarizing beet molasses. In co-operation with 25 beet-sugar factories, an improved method for determining sucrose and raffinose in beet products which had been worked out by the Bureau was tested with satisfactory results. This method makes possible closer chemical control of the recovery of sucrose, thereby assisting in locating and ultimately reducing sucrose losses. An extensive investigation was made in the field on the relation between the composition of sugar beets and the recovery of sucrose from them, particular attention being given to the efficiency of elimination of colloidal non-sugar substances at various hydrogen-ion concentrations and at various stages of the process. Work was started for the purpose of determining the character of substances present in various grades of cane and beet sugar which give rise to objectionable colour in a number of commercial products, including confectionery made from them.[1] The ultimate purpose is to devise suitable means whereby these substances may be eliminated."

DETECTION OF SULPHITES IN FOODSTUFFS (SUGAR, ETC.). **Albert E. Parkes.** *The Analyst*, 1926, 620.

At a meeting of the Society of Public Analysts a method of detecting sulphites in foods was described, this being stated to be simple and rapid. This apparatus consists of a conical flask of 50-100 c.c. capacity, narrow necked, and (as seen in the drawing) closed with a rubber cork carrying a small thistle funnel, bent twice, with a bulb in each limb capable of holding about 2 c.c., the tube of the funnel having an internal diam. of 3 to 4 mm. In this apparatus the issuing gases are concentrated into a small space without loss and made to act on a small volume of reagent. In consequence, it is possible to detect very small quantities of sulphur dioxide. Details are as follows: 10 grms. of solid material are mixed with about 10 c.c. of water and transferred to the conical flask. 10 c.c. of dilute hydrochloric acid (about $2N$ strength) and 2 or 3 small pieces of marble, about the size of peas, are now added, and the flask immediately closed with the rubber cork carrying the thistle funnel. In the funnel are placed 2 to 3 drops of 0·05 N iodine solution and 1 drop of barium chloride solution, which liquid forms a seal through which all gases liberated must pass. When the action of the acid on the marble has moderated, the flask is placed over a small flame and heated gently to boiling. Immediately the first drop of condensed liquid passes over into the funnel, if sulphur dioxide be present, the colour of the iodine is discharged, and a white opalescence due to barium sulphate is formed. Hydrochloric acid is recommended in place of other acids, as it gives a brisker evolution of carbon dioxide gas and is not so liable to contain traces of SO_2. Various other reagents have been tried in the funnel, as iodine solution and starch, bromine solution, sodium iodate solution and hydrogen peroxide; but, while all of these are satisfactory to an extent, that specified is preferred for general work. The process may be made roughly quantitative: Boiling may be continued for 1-2 mins. to drive through all



[1] *I.S.J.*, 1926, 472.

the sulphur dioxide into the the funnel; 0·1 N iodine may be dropped into the funnel with a small pipette until there is an excess; then reagent and precipitate washed into a small beaker and matched against a known amount of sulphuric acid and barium chloride in a nephelometer, or the barium sulphate can be filtered on to a black paper and dried, the amount obtained being compared with known quantities similarly obtained. In the discussion following the reading of this paper, Mr. G. N. HUNTLY pointed out that hydrogen sulphide would decolorize the iodine, though it would not give rise to the barium sulphate precipitate, so that the double effect must be obtained. Dr. MONIER WILLIAMS (Ministry of Health) said the test would be useful for "sorting out" purposes, but it was one for detecting all volatile sulphur compounds, and he recommended the use of hydrogen peroxide. If that reagent were treated with barium chloride and filtered, a clear liquid would be obtained which would react exclusively to sulphur dioxide at ordinary temperatures, giving an immediate precipitate, whereas hydrogen sulphide would react only if the liquid were heated. Mr. PARKES, replying, said that if a little copper sulphate were put in the flask there was not so much liability of getting volatile sulphur compounds other than sulphur dioxide. Hydrogen peroxide had been already tried, but was not particularly advantageous, especially when copper was used. Starch iodate solution could be used in the funnel. Very little sulphur dioxide came off in the cold, while some fruit products contain volatile substances which discharge the colour of iodine, but do not give any reaction with barium chloride solution.

OFFICIAL TRIALS WITH BEET LIFTING MACHINES IN HOLLAND. **Ed. Koppeschaar.** *Tijdschrift*, 1926, *No.* 3, 54-56.

A Committee appointed by the Society for the Promotion of Agriculture and Cattle-breeding, by the Dutch Co-operative Factories' Union and by the Central Sugar Co., have been engaged in studying beet lifting machines, and have offered a prize for a machine which most closely fulfils the demands which according to their specification should be fulfilled, these being as follows: (*a*) Roots must be regularly topped, and by means of an easily adjustable device; (*b*) roots must be lifted with only little adhering earth from heavy as well as from light soils; (*c*) neither roots nor pieces of them must remain in the earth; (*d*) the work must be done by the machine more economically than by hand; (*e*) both the crown and the leaves must be left in a state suitable for use for fodder; and (*f*) the machine must be constructed robustly, the price being in proportion to its construction. Machines which have been seen in operation by the Committee originated from the following firms: SIEDERSLEBEN, Bernburg; WALTER & KUFFER, Schweinfurt; EMILE DEGRÉMONT-LE CATEAU (Nord); GUICHARD-LIEUSAINT (S. et M.); PAUL BELLIER, Aras (Pas-de-Calais); JEAN MOREAU-NOYELLES-SUR-ESCAUT PAR MARCOING; A. DUMAINE-SAVIGNY LE TEMPLE (S et M.), Gare Cesson; MONSTER & VISSER, of Bleiswijk; and CORN VAN DRIEL, of Gouda; In addition the Pommritzer method, involving a hand topper followed by a lifter, and the beet lifter and potato digger of Stoll were examined. But the final conclusion after these considerations was that the problem of beet lifting machines which top at the same time, working well in fulfilment with the demands set, remains unsolved so far as the nature of the soil in Holland is concerned. Throughout, the Committee have always had in mind the following three points which bear essentially on the matter, namely; the value of the leaves for utilization as fodder; the nature of the labour situation; and the possibility of increasing the acreage by means of suitable beet harvesting machines. Two main conclusions reached by the Committee were (1) That mechanical beet lifters with combined lifting and digging devices compared with hand operations as to-day practised in Holland yield such poor results that their introduction cannot be considered; and (2) that the new so called Pommritzer method[1] deserves consideration for obtaining clean tops for fodder; and even when the tops are not fed a serious trial with this method is advisable, as it offers the possibility of lowering the cost and lessening the time of digging. It consists in topping he roots by hand while still in the ground and subsequently raising it with a potato or other suitable lifter.

[1] *Tijdschrift*, September 30th, 1925; and October 31st, 1925.

CLARIFICATION FOR POLARIZATION, USING HYDRATED ALUMINIUM SILICATE. R. T. Balch. *Sugar*, 1926, 28, *No.* 12, 551.

Following the c.c. or two of lead sub-acetate solution, it is customary in the clarification of solutions of raw cane sugars for polarization to add a couple of c.c. of alumina cream, which functions simply as a filter-aid. Numerous tests now show that hydrated aluminium silicate[1] (the active constituent of many clarifying clays, including fuller's earth) fulfils requirements much more effectively, as not only does it assist the rate of filtration, but it also effects a certain decolorization. Some hydrated aluminium silicate is ground to impalpable powder in a ball mill, and mixed with distilled or rain water to form a 5 per cent. suspension, the water being added in small portions at first, and thoroughly mixed to a paste after each addition until the tendency to lump is overcome, after which the remainder of the water is added in a single portion. For most purposes 5 c.c. of this 5 per cent. suspension is sufficient for the clarification of 100 c.c. of solution, and it is added either before or after the lead sub-acetate. No error is introduced, as has been determined by comparative polarizations made after clarification with lead sub-acetate alone, and with a mixture of the two. In the table are summarized data of tests on cane and beet products, from which it will be noted that the silicate is more effective with raw cane sugar than with the other products listed. Compared with alumina cream, the effect of the silicate is to diminish the colour to about half that originally present in the case of the Cuban raws, though the effect is less marked with the other products. However, compared with alumina cream, the generally superior effect of the silicate is marked, and is due no doubt to the flocculation of the latter after being added to the sugar solution, which flocculation removes from solution by adsorption or occlusion a greater quantity of impurities than if it had been added in the flocculated state.

Material	Concentration grms per 100 c.c.	Clarifying Agents (1) Basic lead acetate solution (55° Brix) c.c.	(2) Alumina cream* c.c.	(3) 5 per cent Aluminium silicate suspension* c.c.
Raw sugar (dark Cuban)	26·0	2·5	5	5
Raw sugar (light Cuban)	26·0	2·0	5	5
Beet molasses	13·0	10·0	5	5
Cane molasses (Cuban blackstrap)	6·5	12·0	5	5
Cane syrup (Georgia)	26·0	5·0	5	5

Material	Colour after clarification Approx length of column for colour equivalence (1) mm	(2) mm	(3) mm.	Time required for filtering 50 c.c (1) min. sec.	(2) min	sec	(3) min	sec
Raw sugar (dark Cuban)	70	77	100	Cloudy	4	20	2	40
Raw sugar (light Cuban)	—	66	100	Cloudy	4	—		10
Beet molasses	—	80	100	2 5	2	10	2	15
Cuban molasses (Cuban Blackstrap	—	80	100	Cloudy	4	—	5	—
Cane syrup (Georgia)	—	77	100	——	2	10	2	20

(*A*) INTERNAL COMBUSTION LOCOMOTIVES FOR PLANTATION USE. Irwin McNiece. *Report presented to the 4th Annual Convention of the Philippine Association*, 1926. (*B*) HIGH COMPRESSION RATIOS NOT NECESSARY FOR ALCOHOL. *Technical News Bulletin of the Bureau of Standards*, *No.* 100.

(*A*) In 1920 Mr. A. H. EHLE took out patent rights covering designs of a gasoline locomotive based on modern steam engine practice. These patents have been the basis on which one of the largest locomotive builders in the world has developed

[1] *Cf.* WELLS. *I.S.J.*, 1924, 109; BACHLER, *I.S.J.*, 1916, 386; 1919, 308

*Alumina cream and hydrous aluminium silicate were used in combination with the volumes of basic lead acetate solution shown in column 1 (clarifying agents) except in the case of Cuban blackstrap where the volume used was 7 c.c.

an extended line of these gasoline units which have entirely demonstrated the soundness of the original ideas. These engines used in and around plantations, quarries, brickyards, lumber mills, smelting plants, and switching yards have proven to be clean, dependable, safe, and efficient over the range of speed and power for which they are designed. Their radius of operation depends only upon the size of the fuel tank; and using a small amount of water for engine cooling only, they are especially serviceable in localities where water for steam locomotive boilers is scarce or hard to get. The menace of cane fires due to sparks from steam engines is eliminated; and when equipped with self-starters, the engine can be stopped even for short periods when not needed with a corresponding saving of fuel. The first cost of these engines is comparable with that of steam engines of equal hauling characteristics, so that they should be carefully considered when choosing plantation equipment. These engines have been developed to operate on gasoline (and with proper changes in manifold carburetter and other parts on naphtha, alcohol, kerosene or distillates of 42° Bé. or higher) in sizes ranging from 5 to 25 tons inclusive, and therefore meeting all the requirements of average industrial service. Of extreme interest is the fuel consumption, which in general may be said to be about 1/10 of a gallon per h.p. hour. For ordinary requirements, it is safe to place the fuel consumption throughout the working day at one-half the rated h.p. of the engine. For a special unit, say the 15-ton type, this would work out about as follows. The h.p. rating of this engine is 100 at 550 r.p.m. It has six cylinders, 7½ in. × 9 in., and develops a draw-bar pull on straight level track of 7100 lbs. at four miles per hour or 4600 lbs. at six miles per hour. Assume that this engine is handling loaded cane cars, and that the total resistance, due to track and speed, is 35 lbs. per ton. Then, 7100 divided by 35 will be 203 tons or about 30 loaded cars. Allowing 10 hours' working time out of the 24, there will probably be expended a total of 500 h.p. hours (that is, 50 × 10), indicating a consumption of 500 × 1/10 or 50 gallons of fuel. Maintenance and repairs for the gasoline locomotive will be far less than for the steam units which are ordinarily overhauled, to some extent at least, each season. In conclusion, it may be said that the gasoline type of locomotive has a definite place on the sugar plantation, especially when used in the small sizes for shunting. In this field they are far more economical than a small locomotive and require less up-keep. When used with alcohol as fuel, which may be a by-product of the central, they will show astonishingly low operating costs.

(*B*) In some recent articles it has been implied, if not expressly stated, that a high-compression ratio is necessary. That this is not true is fortunate, as manufacturers would be very loth to alter their engines in such fashion as to render then unsuitable for operation with gasoline. The fact is that alcohol permits, but does not require, the employment of a much higher compression ratio than gasoline. Should alcohol or other fuels of equal anti-knock value become generally available, compression ratios could be increased and as a consequence higher efficiencies could be attained. In the meantime the chief advantage to be derived from the use of an anti-knock fuel is that it permits satisfactory operation with an engine too badly carbonized for satisfactory operation. Alcohol does require larger metering jets or a larger needle valve opening in the carburetter. This is necessary both for the reason that alcohol is more viscous than gasoline, and because a much richer mixture of alcohol and air is required for complete combustion than of gasoline and air. Fortunately, this change can be made ordinarily with little difficulty.

Boiling Up Carbonated Juice. **Vl. Mayer.** *Zeitsch. Zuckerind. Czecho-Slov.*, 1926, **51**, 65, 73. A study of the rate of precipitation of calcium carbonate on boiling up carbonated juice leads the author to conclude that in general this reaction is so slow that in the majority of factories the duration of boiling is insufficiently prolonged for any useful effect to result.—Adsorption of Inorganic-Ions by "Carboraffin" and "Supra-Norit" in the Filtration of Thick-Juice (Syrup) in Beet Sugar Manufacture. **J. Fiser.** *Zeitsch. Zuckerind. Czecho-Slov.*, 1926, **51**, 49-56, 57-59. On comparing the adsorptive power of "Carboraffin" and "Supra-

Norit " in respect of mineral matter after the filtration of beet syrups, the author arrives at the following conclusions : Silica is adsorbed by neither ; but iron and alumina are taken by the most readily of all the inorganic-ions, " Supra-Norit " being the more active in this respect. Calcium is adsorbed more by " Carboraffin " and magnesium is taken up to a slight extent only by both. Alkalis are adsorbed but little by " Carboraffin," while during the filtration over " Supra-Norit " they pass over from the carbon to the juice, being replaced by another ion. Sulphuric acid is not taken up much by either carbon, and chlorine is more adsorbed by " Supra-Norit " than by " Carboraffin."—RELATIVE MERITS OF MONO-, DI-, OR TRICALCIC PHOSPHATES AS SOIL FERTILIZERS. **S. L. Kling.** *African Sugar and Cotton Planter*, 1926, **2**, No. 10, 8-8. Evidence of research work done in the last decade proves the application of mono-calcic phosphate to be uneconomical, and that the choice of the type of basic phosphate most profitably used on a farm depends upon the cost at per unit of P_2O_5 and upon the soil conditions of that farm. These soil conditions may defer the availability of di- or tribasic phosphates for a shorter or longer period, but these forms of phosphates can never be lost altogether to the farmer.—SUSCEPTIBILITY OF THE BEAN TO THE VIRUS OF THE SUGAR BEET CURLY TOP. **Eubanks Carsner.** *Journal of Agricultural Research*, 1926, **33**, No. 4, 345-348. That the bean is not a favourable food plant for the insect is indicated by the fact that in cage experiments all of the leaf hoppers died within 17 days after being caged on the beans. Principally on this account the writer is inclined to the opinion that it is only in seasons when the leaf hopper is relatively very abundant that serious damage to the bean crop from curly top may be expected, rather than that the disease will be a continual menace as it is to sugar beets.—RUTH'S STEAM ACCUMULATOR. **Anon.** *Chemistry and Industry*, 1926, **45**, No. 27, 851-855. A general article describing the functions of this apparatus,[1] which is installed in 11 plants in the United Kingdom including the beet factory of the Anglo-Scottish Beet Sugar Corporation, Ltd., at Colwick. There are 1107 in Norway and Sweden, 60 in Germany, 18 in Finland, 17 in Holland, 16 in France, 9 in Czecho-Slovakia, and 2 in the Dutch East Indies.—FLUID HEAT TRANSMISSION FOR HIGH TEMPERATURES IN INDUSTRIAL PROCESSES. **J. A. Reavell.** *Journal of the Society of Chemical Industry*, 1926, **45**, No. 45, 367-376T. Describes the Kestner oil circulation heating system (Merrill patent).—CONCRETE TANKS FOR CHEMICALS. **Anon.** *Chemical Trade Journal*, 1926, **79**, No. 2059, 524-525. Molasses is said to be capable of being stored underground in concrete tanks, sometimes without any surface coating, though in other cases the tanks have been finished by treatment with a mixture of coal tar pitch, Portland cement and kerosene or other suitable preparation.—SUCROSE LOST IN ENTRAINMENT. **C. F. Bardorf.** *Canadian Chem. Met.*, 1925, **10**, 175-177. In a vacuum pan of coil type provided with a device for catching entrainment particles apart from the splashings, the sucrose passing over was found to be 0·057 and 0·083 per cent. of the total sucrose. Purity of the entrained liquors was much lower than in the original liquor in the pan, remarkably high contents of ash being found, viz., 14·46 and as compared with 0·7 in the solids of the original liquor. Dissociation of mineral and organic salts is regarded as an important factor in entrainment phenomenon.—ENSILAGE OF SUGAR BEET TOPS. **H. E. Woodman and A. Amos.** *Journal of Agricultural Science*, 1926, **16**, 406-415. Silage of good value can be made from beet tops alone or with wheat chaff, or from beet tops and wet beet pulp ensiled in alternate layers. Analyses of these materials before and after ensiling are given, and digestion experiments on sheep with silage from a mixture of tops and pulp are discussed.—FILTRATION CONSTANTS OF VARIOUS CARBONS (" NOBRAC "). **H. I. Waterman and A. Dauvillier.** *Recueil des Travaux chimiques des Pays-Bas*, 1926, **45**, *No.* 9/10, 628-632. In a previous study the filtration constants of " Norit " and " Carboraffin " were established,[2] and now " Nobrac " is considered. Contrary to the other two carbons, the effect of " Nobrac " on the rate of filtration becomes greater as the pressure is raised, the reason of this probably being the greater compressibility of this carbon.

J. P. O.

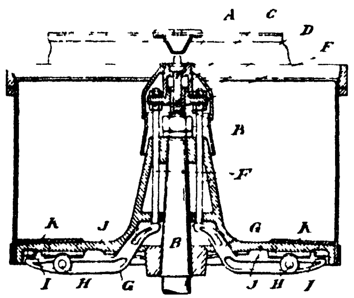
[1] *I.S.J.*, 1924, 607. [2] *Recueil*, 1924, **43**, 737.

Review of Recent Patents.[1]

UNITED KINGDOM.

CENTRIFUGAL MACHINE FOR PILÉ (LUMP) SUGAR. **Richard Lehky**, of Buenos Aires, Argentina. 260,509. May 19th, 1926.

In the centrifuging of *pilé* sugar there is at present a considerable difficulty and loss of time involved in having to loosen the moulds which divide up the lumps of sugar in order that these may be taken out easily. Even after the removal of the moulds, the lumps of sugar generally remain adhering to the sides of the drum, making the work of taking them out more difficult. This invention overcomes these objections, as will be understood from the following description of the new apparatus:



A is a screw which works in the upper extremity of the axle *B* and has a part of its head let into the capsule *C*, to which is fitted the bell-shaped cover *D*. This screw secures at will the axial displacement of the flange *E* conjointly with the vertical arms *F* suitably fixed to same. These arms exert pressure upon the raised extremity of the levers *G* which oscillate on the fulcrum *H* having for their object the lifting of the pins *I*, which, passing through the principal base *J* lift the ring *K* which is superposed on the said base. Working is substantially as follows: When the usual period of centrifuging is completed, the screw *A* is turned, by means of a key, and moved so that it descends. By this movement, the parts *C*, *D*, *E* and the arms *F* are forced to descend. The lower extremities of these arms press each upon its respective lever *G*, which, being balanced upon the pins or fulcrums *H*, suitably secured to the lower wall of the principal base, cause the other extremity to lift the pins *I*, which in turn lift the ring *K*. By this simple operation, the easy and rapid removal and detachment of the lumps of sugar from the walls of the drum is obtained. The elements described may vary in their constructional form, according to the capacity and construction of the centrifugals to which are to be applied the improvements which are the object of this application.

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MANUFACTURE, REVIVIFICATION, AND APPLICATION OF ACTIVATED (DECOLORIZING) CARBON. **Verein für Chemische Industrie A.-G**, of Frankfurt, Germany. (*A*) 259,616. October 11th, 1926; convention date, October 12th, 1925. (*B*) Also 260,567; addition to 259,616. October 11th, 1926; convention date, October 27th, 1925.

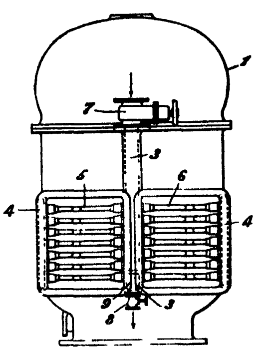
(*A*) Carbon is activated, or spent activated carbon is re-activated by treating it at elevated temperature with a stream of dry or moist gas containing free oxygen, such as air, whereby partial oxidation occurs, the gas being supplied under pressure or by means of suction, intermittently or continuously. Preferably the carbon to be treated is in granular form and the treatment is carried out in tubes having permeable walls which may be made of iron besides clay and fire clay, whereby the products of combustion are readily removed and coking thus prevented. The speed of the stream of gas, the time of treatment, the thickness of the layer of carbon, and the size of its granules may be varied. In one example carbon is activated in an iron tube by means of a gas containing oxygen and in a second example spent

[1] Copies of specifications of patents with their drawings can be obtained on application to the following—*United Kingdom*: Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price 1s. each). Abstracts of United Kingdom patents marked in our Review with a star (*) are reproduced from the *Illustrated Official Journal* (*Patents*), with the permission of the Controller of H.M. Stationery Office, London. Sometimes only the drawing or drawings are so reproduced. *United States*: Commissioner of Patents, Washington, D.C. (price 10 cents each). *France*: L'Imprimerie Nationale, 87, rue Vieille, du Temple, Paris. *Germany*: Patentamt, Berlin, Germany.

carbon originally prepared by means of zinc chloride is re-activated. (*B*) According to the additional Specification the oxygen or gas containing oxygen is led into the reaction container by diffusion through the walls thereof, which container may be heated directly or indirectly and the oxgyen may be supplied merely by ensuring that the combustion gases supplying the necessary heat contain excess oxygen. Thus, a container may be heated electrically by means of a jacket in such a way that air can pass between the jacket and the container. The material to be activated, e.g., wood charcoal rests upon a perforated baseplate which is supported by a pipe carried on a withdrawable damper which enables the activated product to be discharged. During the diffusion process gases may be introduced directly through an inlet. Both dust and granular carbon may be treated, but before use the dust may also be agglomerated into cakes by means of a binder such as wood-tar and then calcined to carbonize the binder, possibly in a separate heating chamber. Active carbons for different purposes may be produced by varying the thickness of the carbon layer, the speed and duration of the diffusion of the oxygen and also the temperature of the activation. The gases may be supplied by maintaining a suitable pressure or by suction.

HEATING COILS FOR VACUUM PANS. **Harold Hillier,** of Westminster, London. 260,387. September 8th, 1925.

Numeral 1 represents the shell of the pan, 2 the doors, 3 the central chamber, 4 the wing chamber, 5 the left hand coils and 6 the right hand coils, 7 the steam inlet valve, and 8 the drainage outlet valve. The coils 5 and 6, which may be of the single or double type, are arranged in substantially horizontal planes, and are divided into two groups of coils, a left-hand group 5 and a right-hand group 6. Each coil of the left-hand group 5 and the corresponding coil in the right-hand group 6, are connected to the central chamber 3, between the doors 2 by the same coupling device which passes through their end fittings and the chamber 3, while the other end of each of the coils is separately connected to the wing chamber 4 formed at the side of each of the doors 2 by means of a coupling device 14. The lower portion of the central chamber 3 may be separated by a partition 9 and the lower coils in the evaporator so arranged that the hot drainage water flowing into the wing chambers 4 from the upper coils is constrained to pass through the lower coils into the lower and separate portion of the central chamber 3 formed by the partition 9. With this arrangement the maximum amount of heat is abstracted from the heating steam and the efficiency of the evaporator is increased. In another arrangement, a steam from separate sources is admitted to each wing chamber and the drainage resulting from the condensation of the heating steam in the coils flows into the central chamber and thence through the lower coils into the bottom portions of the wing chambers, the bottom portion of each wing chamber being divided from the upper portion by a partition rib. In another modification, the group of coils may be further subdivided by arranging partitions and in the central chamber and the wing chambers respectively, so that the left-hand groups of coils is divided into two separate groups, and the right-hand group of coils is divided into two separate groups so that a separate supply of steam may be led into each separate group of coils. Steam is introduced by means of screw lift valves and it will be understood that it passes into the respective coils through a suitably designed coupling and that the condensed steam leaves the respective coils through a corresponding coupling at the other end of the coils. the water being drained off directly through the valves or passed through the lower coils before being drained off through the valves.

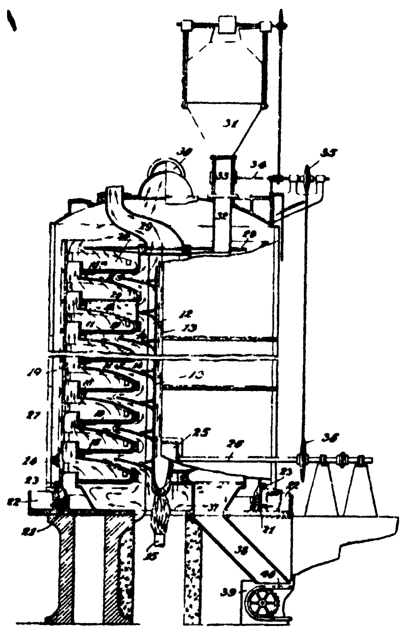


ALCOHOL MOTOR FUEL. **Benzol Verband Ges.**, of Bochum, Germany. 257,881. December 14th, 1925: convention date, September 4th, 1925. A salt of benzoic acid, preferably 0·2-0·3 per cent. of sodium benzoate, is added to alcohol or mixtures of ethyl alcohol or its homologues with benzol or other liquid, to prevent corrosion of metals in carburetters, storage tanks, etc.—REMOVING AND PREVENTING INCRUSTATION IN BOILERS. **J. Billwiller**, of Glarus, Switzerland. 257,915. August 24th, 1926; convention date, September 1st, 1925. Incrustation in boilers is removed and prevented by adding resin acid to the boiler or feed water. Resin acid is preferably made into a paste with glycerine, wood gum, tragacanth or dextrine, or it may be used in solution in alcohol, or the solution may be employed for making a paste. Instead of resin acid, a substance containing it may be used, e.g., resin, gum-resin, colophony or the like, and in the boiler the resin acid is liberated. PREPARATION OF MANURE FROM CELLULOSIC MATERIAL. **Fäkaltorfstudien Ges. and A. Baumgarten-Crusius**, of Dresden, Germany. 258,149. January 21st, 1926. Cellulosic constituents of vegetable materials are broken up by treatment with a mixed culture of aerobic and anaerobic micro-organisms, adapted to ferment cellulose and obtained from farm soil, horse manure, garden and leaf mould, forest soil, etc. These materials are heated to 60° C. to destroy undesired bacteria, and separate portions of the different materials are then exposed as loose layers to air at a temperature of 50° C. while other portions are heated to 50° C. under anaerobic conditions. The two cultures, aerobic and anaerobic, so obtained from each of the different classes of substance are lixiviated with a single colloidal peat solution containing small quantities of ammonium sulphate and sugar, and this solution is added to sterilized matter of the class from which the cultures have been obtained. The several batches of material so inoculated are mixed together and the mixture, after fermentation, is added to a mixture of farm soil, horse manure, beech leaves and peat, etc. This mixture after further fermentation is added to the vegetable material which is to be decomposed. In an example it is added to a mixture of peat, faecal matter and Thomas slag.—EVAPORATION WITH THERMO-COMPRESSION. **Soc. des Condenseurs Délas**, of Paris. 258,165. February 27th, 1926; convention date, January 18th, 1925. A steam-jet ejector for compressing the vapours evolved in an evaporator and passing them through a pipe into a heating space is provided round the compression space with a jacket through which fresh liquid from a pipe is passed on its way to the evaporator. The liquid becomes preheated, and the action of the steam-jet ejector is rendered more stable. A second preheater may be used after the ejector or arranged in parallel with the ejector. In the case of multiple-effect apparatus, the ejector withdraws vapours from the final effect and compresses them into the first effect.—UTILIZATION OF DISTILLERY SPENT-WASH (VINASSE) FOR DUST-LAYING COMPOSITIONS. **Nederlandsch-Indische Spiritus Mij., and T. J. A. Jacometti**, of Amsterdam. 258,408. August 20th, 1925. Roads are rendered dust free by treatment with the sugar-free residual liquor resulting from the manufacture of alcohol by the fermentation of molasses, the liquor being first concentrated by evaporation and then treated with alkali so that hygroscopic salts are formed. Hygroscopic substances such as the chlorides of lime and magnesium may be added. The residual liquor may be evaporated until a dry powder is formed which is diluted with water when required for use. Disinfectants may be added to the powder. The residual liquor may be sprayed on the road surface or worked up with the materials used for laying out or repairing roads.—ALCOHOL MOTOR FUEL. **E. V. Bereslowsky**, of New York. 258,550. June 30th, 1926; convention date, September 17th, 1925. Motor spirit consists of gasolene, kerosene, or other low-compression fuel and mesitylene or a derivative, e.g., mono-, di-; or tri-amino mesitylenes, or their methyl or ethyl compounds. A blending agent, e.g., benzol or alcohol may be added. In an example 20 grms. of diamino-mesitylene is dissolved in 20 c.c. of ethyl alcohol and mixed with 1 gallon of gasolene. The compression that may be used before causing " knocking " is thereby raised about 20 lb. The mesitylene may be fed direct to the combustion chamber or the intake of the engine.

UNITED STATES.

UNIFORM REVIVIFICATION OF ACTIVATED (DECOLORIZING) CARBON, E.G., "DARCO." **Victor S. Allien** (assignor to **Darco Sales Corporation**, of New York). 1,599,072. September 7th, 1926.

In the drawing there is shown a furnace having a central supporting structure for the material, through which the heating gases are passed. Around this is a rotating structure which serves to advance the material, and outside of this is the stationary protecting and sealing casing. The centre structure includes a series of superposed annular shelves or decks 10, each of which has a chamber 11 therein, opening to a centrally disposed vertical flue 12 through which the heating gases pass. An inner flue 13 has a series of annular baffles 14 thereon, each of which extends out into the chamber of a corresponding shelf or deck whereby the heating gases are deflected out into each chamber and may then pass back to the flue 12. The heating may be produced for instance by a fuel burner 15 at the lower end of the flue 13, and outside of the latter, so that the lower shelf is subjected to the highest temperature and the temperature continually decreases toward the top. To avoid pockets at the outer edge or periphery of each chamber 11 there is provided an annular passage 16 below the supporting surface of each shelf 10, and at the peripheries of the several annular chambers 11. The inner wall of each passage 16 has a series of apertures 16[a] therethrough for the passage of gases from the chamber 11 into the passage, and each passage 16 is connected to the inner flue 13 by a radially disposed conduit 17 so that the gases which pass from the chambers 11 through the openings into the passage 16, may escape directly through the conduit 17 to the inner flue 13 without being caused to pass out into the chambers 11 of the superposed shelves. By making the openings in the passage 16 of progressively increasing size from adjacent the conduit 17 to a point diametrically opposite thereto, there is secured a uniform withdrawal of gas from each chamber 11 along the entire periphery thereof. Each shelf 10 has a vertical slot or opening 18 therethrough and extending radially across the entire width of the shelf so that as the material is advanced along the shelf to the opening 18 it may drop through to the shelf below. These openings 18 are so positioned in the several shelves that the material upon reaching a shelf is caused to travel along the shelf through nearly one complete revolution before it drops through to the shelf below, each opening being slightly in the rear of the opening in the shelf above. For advancing the material along the shelves there is provided a rotatable sleeve 19 which has a plurality of radially extending blades 20 carried thereby properly juxtaposed to each shelf. There are a large number of these blades for each shelf so that the material on each shelf is acted upon by a series of the blades and kept in a substantially uniform layer upon the shelf. Above the upper shelf there is provided an annular plate 28 with a central opening communicating with the upper end of the flue 12 and an outlet flue 29 may be connected to the upper end of this flue 12 so as to conduct from the outer casing the gases of combustion. The inner flue 13 may terminate in an open end within and adjacent to the upper end of the flue 12 so that all of the gases of combustion which have passed into the inner flue 13 through the several radial conduits 17 may unite with the other gases of combustion and escape through the flue 29. For delivering



material to the furnace, there is provided a hopper 31 delivering through a conduit 32, the lower end of which extends through the plate 28 to a point above the upper plate 28 to a point above the upper shelf 10. At the lower end of the hopper there is provided a rotatable feeding device 33 which may be in the form of a drum having pockets therein so that as the drum rotates each pocket receives material when on the upper side of the drum and delivers it from the lower side, By varying the size of the pockets in the feeding mechanism the delivery of material may be accurately controlled. The speed of rotation of the feeding mechanism should be such that a separate charge is delivered to the shelf as each blade 20 passes beneath the lower end of the conduit 32. The shaft 34 of the feed drum may be provided with a sprocket 35 which may be connected by a chain to a sprocket 36 on the shaft 26 which rotates the blades 20. In revivifying carbon the temperature at the lower shelf will be 1100° F. to 1350° F., while at the top shelf it may be about 550° F. to 600° F. The furnace permits of the careful admission or complete exclusion of air, as there is only one stuffing box and the remainder of the casing may be easily constructed absolutely air-tight. The gentle sweeping or rolling movement for the carbon does not abrade it.

CARBONATING APPARATUS. **Basil H. Savage,** of San Francisco, Cal., U.S.A. 1,598,936. September 7th, 1926. Apparatus for charging a liquid with a gas, includes a chamber, means for admitting the liquid into the same, means for admitting the gas into the chamber and a float control for the gas including a plurality of inverted bells mounted above one another in spaced relation, each being adapted to trap a layer of gas, and having a downwardly extending central flange with an outlet therein disposed intermediately of the top of the bell and the lower extremity of the bell, said outlet being adapted to allow a surplus of gas to escape into the next higher bell.—RECOVERY OF ALCOHOL, ORGANIC ACIDS, AND FERTILIZER FROM FERMENTED SACCHARINE MATERIALS. **Gustave T. Reich,** of Anaheim, Cal. 1,599,185. September 7th, 1926. A process of treating fermentation liquid for the production of alcohol comprises neutralizing the fermentation liquid, evaporating the neutralized fermentation liquid and collecting a fraction containing the bulk of the alcohol content of the fermentation liquid, calcining the evaporation residue, and recovering organic acids and fertilizer material therefrom.—MANUFACTURE OF SUGAR FROM WOOD. **Eduard Färber,** of Heidelberg, Germany (assignor to the **International Sugar and Alcohol Co., Ltd.,** of London). 1,599,462. September 14th, 1926. A method is claimed for the production of pure, fermentable, and crystallizable sugar from wood sugar, comprising introducing a finely subdivided alkaline earth oxide into a strong, raw, wood sugar solution, separating out the resulting sugar-alkaline earth compounds, liberating the polysaccharides from the separated sugar-alkaline earth compounds by means of acid, which form insoluble alkaline-earth metal, and then hydrolysing the wood sugar solution thus purified.—EVAPORATOR. **Harry Fothergill,** of Westminster, London, S.W. 1. 1,600,106. September 14th, 1926. Apparatus is described for evaporating liquids comprising a heater, an evaporating chamber to which the heated liquid is delivered, a pump for circulating the liquid through the heater and to the evaporating chamber, nozzles to which the heated liquid is delivered by the circulating pump, said nozzles being so designed as to offer such resistance to the flow of liquid through them that the pressure in the discharge side of the circulating pump is maintained above atmospheric pressure and a discharge pipe connexion for concentrated liquid leading from the discharge side of pump through which concentrated liquid is delivered against atmospheric pressure.—MANUFACTURE OF CRUDE LACTOSE (MILK SUGAR). **Raymond W. Bell.** 1,600,573. September 21st, 1926. A process is protected for the manufacture of crude milk sugar, consisting in removing the casein and fat in the milk so as to obtain whey, the acid reaction of which is adjusted to a *pH* of about 7·0 by the addition of suitable alkali, forewarming the whey thus treated to about 60° C., concentrating the whey at a temperature below the coagulating point of the albumen contained therein to a concentration at which the lactose just fails to crystallize, cooling the concentrate to about 10° C., maintaining such last-named temperature until a maximum crystallization of the lactose has taken place, and removing the lactose crystals by any suitable means, such as centrifuging.—STOCK-FEED CON-

TAINING A BACTERIAL PREPARATION FOR THE DIGESTION OF CELLULOSE. **Herman C. Reinhold and Francis L. Fultz**, of Lancaster, Pa. 1,601,323. September 28th, 1926. Claim is made for a stock feed containing *B. Pasteuriana* in amount sufficient to aid in the digestion of cellulose materials.—FERMENTATION OF CELLULOSIC MATERIALS. **Herbert Langwell**, of Epsom, England. 1,602,306. October 5th, 1926. Claim is made for a process for the fermentation of cellulosic materials, according to which the hydrogen ion concentration is maintained within the limits about 10^{-9} and 10^{-5}, measured in the bulk of the mash by the employment of a compound of an alkali metal (including ammonium) after the addition of a compound of an element of which the phosphate is substantially insoluble in water.—BEET TOPPER. **Jacob J. Sprunger**, of Fort Wayne, Ind. 1,606,110. November 9th, 1926. Claim 1 reads : In a beet topper, a frame including frame sides each provided with a pair of vertically spaced aligned bearings, shafts each supported in a respective pair of said bearings, said shafts being vertically adjustable in said bearings, said means to hold the shafts in vertically adjusted position, a drum shaft extending between the frame sides, a drum mounted on said drum shaft to support the frame in position relative to beets and the like, means to drive the first mentioned shafts, a bracket at the upper ends of the first shafts and having lateral portions through which said shafts pass, collars on the shafts and located on opposite sides of the lateral bracket portions, means to hold the collars in adjusted position relative to the shafts, a drive shaft supported horizontally on said bracket, and operatively connected to the first shafts.—PREPARATION OF DIATOMACEOUS EARTH (KIESELGUHR) **Richard C. Williams**, of Baltimore, Md. 1,606,281. November 8th, 1926. Whole skeletal frames of diatoms are separated technically by mixing raw diatomaceous earth with a relatively large quantity of water, adding thereto a deflocculating substance, permitting the mixture to deflocculate, adding a flocculating substance, permitting the heavier whole frames to settle to the bottom of the mixture, and removing the unsettled broken frames and impurities with the supernatant water.—SPRAYING SUGAR. **Eugene Roberts** (assignor to **The Western States Machine Company**, of Salt Lake City, Utah). 1,604,102. October 19th, 1926. In an apparatus for spraying the contents of a centrifugal basket for the combination of a supporting casting, a vertical actuating shaft mounted therein, timing mechanism operatively connected with the lower portion of said actuating shaft and acting, after a predetermined interval, to cause the cut-off of the liquid spray, a horizontal driving shaft forming an intermediate connexion between said actuating shaft and the basket spindle of the centrifugal through the medium of friction pulleys, and means for automatically swinging said horizontal shaft away from its driving connexion with the basket spindle, said means being controlled by the timing mechanism to operate when the spray is cut off, substantially as described.—APPLICATION OF ACTIVATED (DECOLORIZING CARBON ("CARBROX"). **Christian J. Gambel**, of New Orleans, La. (*A*) 1,606,215. November 9th, 1926. (*B*) 1,606,216. November 9th, 1926. Claim is made for :—(*A*) The process of refining sugar which consists in subjecting a solution of unwashed raw sugar to a clarifying partial decolorizing action in the presence of lime, an inert filtering material, and a quantity of "Carbrox" sufficient to effect a partial decolorization of said solution while maintaining the latter in an alkaline condition ; filtering said clarified solution ; decolorizing the filtrate thus produced ; and concentrating said decolorized filtrate sufficiently to produce refined sugar, substantially as described. (*B*) The process of refining sugar which consists in clarifying and filtering a solution of sugar ; subjecting the filtrate in an agitator to the action of a quantity of " Carbrox " equal to as little as three-fourths of a lb. to each 100 lbs. of sugar present to partially decolorize the same ; subjecting the partially decolorized solution to a second filtering action ; and producing refined white sugar in the manner known from the second filtrate thus obtained, substantially as described.—CONTINUOUS FILTRATION. **Fred W. Manning**, of Berkeley, Cal., U.S.A. 1,604,649—1,604,652. October 26th, 1926. These four specifications describe processes of building filtered solids upon a spiral filter wall between such wall and the liquids to be filtered passing the liquid through the filtered solids and filter wall, and moving the filtered solids along the wall.

Sugar Crops of the World.

(Willett & Gray's Estimates to December 16th, 1926.)

	Harvesting Period.	1926-27. Tons.	1925-26. Tons.	1924-25. Tons.
United States—Louisiana	Oct.-Jan. ..	88,000	124,447	79,002
Texas	,, ,, ..	—	—	—
Porto Rico	Jan.-June ..	550,000	544,484	589,760
Hawaiian Islands	Nov.-June ..	714,000	705,350	692,804
West Indies—Virgin Islands	Jan.-June ..	6,000	5,664	7,200
Cuba	Dec.-June ..	4,500,000	4,884,658	5,125,970
British West Indies—Trinidad	Jan -June ..	70,000	73,561	69,628
Barbados	,, ,, ..	50,000	47,535	49,315
Jamaica	,, ,, ..	50,000	57,675	42,843
Antigua	Feb.-July ..	18,000	12,800	17,300
St. Kitts	Feb.-Aug. ..	14,000	16,380	15,563
Other British West Indies	Jan.-June ..	6,000	7,500	6,253
French West Indies—Martinique	Jan.-July ..	45,000	48,121	47,995
Guadeloupe	,, ,, ..	35,000	32,998	39,990
San Domingo	Jan.-June ..	335,000	354,720	311,270
Haiti	Dec.-June ..	12,500	11,249	8,280
Mexico	,, ,, ..	175 000	190,282	165,223
Central America—Guatemala	Jan.-June ..	33,000	25,151	25,562
Other Central America	,, ,, ..	70,000	62,500	73,240
South America—				
Demerara	Oct.-Dec. and May-June ..	95,000	107,580	90,874
Surinam	Oct. Jan. ..	13,000	10,000	10,200
Venezuela	Oct.-June ..	19,000	19,000	20,625
Ecuador	Oct.-Feb. ..	18,000	16,976	18,700
Peru	Jan.-Dec. ..	275,000	265,000	310,522
Argentina	May-Nov. ..	486,000	395,733	246,717
Brazil	Oct.-Feb. ..	700,000	650,000	812,493
Total in America		8,377,500	8,669,364	8,877,329
Asia—British India	Dec.-May ..	3,000,000	2,923,000	2,548,000
Java	May-Nov. ..	1,970,000	2,278,900	1,977,490
Formosa and Japan	Nov.-June ..	450,000	498,460	458,836
Philippine Islands	,, ,, ..	520,000	436,000	581,064
Total in Asia		5,940,000	6,136,360	5,565,390
Australia	June-Nov. ..	425,000	522,344	435,680
Fiji Islands	,, ,, ..	85,000	90,000	100,810
Total in Australia and Polynesia		510,000	612,344	536,490
Africa—Egypt	Jan.-June ..	90,000	95,000	79,918
Mauritius	Aug.-Jan. ..	195,000	241,220	224,710
Réunion	,, ,, ..	50,000	59,015	52,380
Natal	May-Oct. ..	217,000	214,152	143,974
Mozambique	,, ,, ..	65,000	70,000	44,278
Total in Africa		617,000	679,387	545,260
Europe—Spain	Dec.-June ..	7,500	9,000	8,087
Total cane sugar crops		15,452,000	16,106,455	15,532,556
Europe—Beet sugar crops		6,927,000	7,441,441	7,083,068
United States—Beet sugar crop	July-Jan. ..	810,000	804,439	974,185
Canada—Beet sugar crop	Oct.-Dec. ..	28,000	32,475	36,200
Total beet sugar crops		7,765,000	8,278,355	8,093,453
Grand total Cane and Beet Sugar	**Tons..**	**23,217,000**	**24,384,810**	**23,626,009**
Estimated decrease in the world's production	,, ..	1,167,810	*758,801	*3,516,701

* Increase.

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	One Month ending December 31st.		Twelve Months ending December 31st.	
Unrefined Sugars.	1925. Tons	1926. Tons.	1925. Tons.	1926. Tons.
Poland	1,758	500	11,116	13,574
Germany	....	5,543	1,962	13,694
Netherlands	....	....	....	....
France	...	. ..	....	....
Czecho-Slovakia	. ..	....	1,030	342
Java	.	50	26,978	50
Philippine Islands		....	....	....
Cuba	64,550	2,426	724,666	273,488
Dutch Guiana	....	....	....	....
Hayti and San Domingo	....	....	135,262	106,970
Mexico	....	..	....	....
Peru	13,542	11,729	78,666	122,804
Brazil	....	5,645	6,633	6,867
Mauritius	48,911	29,190	84,872	204,081
British India	....	....	....	....
Straits Settlements	....	...	....	....
British West Indies, British Guiana & British Honduras	6,713	1,727	129,027	98,904
Other Countries	29,677	13,472	152,239	228,209
Total Raw Sugars	**165,151**	**70,282**	**1,352,451**	**1,068,983**
Refined Sugars.				
Poland	2,256	1,474	16,701	11,720
Germany	638	6,955	7,781	30,370
Netherlands	33,924	7,487	236,710	236,687
Belgium	1,200	934	15,904	15,299
France	....	....		....
Czecho-Slovakia	30,962	45,067	194,333	316,798
Java	....	....	....	....
United States of America	8,682	110	173,179	12,057
Canada	5,561	1,771	108,303	65,948
Other Countries	4,788	5	9,737	10,602
Total Refined Sugars	**88,010**	**63,803**	**762,648**	**699,480**
Molasses	23,764	16,106	215,595	152,808
Total Imports	**276,925**	**150,191**	**2,330,694**	**1,921,271**

EXPORTS.

British Refined Sugars.	Tons	Tons.	Tons	Tons.
Denmark	117	41	1,019	1,227
Netherlands	52	35	313	487
Irish Free State	4,555	4,404	55,329	51,952
Channel Islands	62	52	900	757
Canada	....	....	....	....
Other Countries	326	535	8,320	23,416
	5,112	5,067	65,880	77,839
Foreign & Colonial Sugars.				
Refined and Candy	163	226	2,165	2,690
Unrefined	53	87	743	1,212
Various Mixed in Bond	....	....	....	....
Molasses	56	16	482	2,288
Total Exports	**5,384**	**5,396**	**69,270**	**84,029**

Weights calculated to the nearest ton.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1926. Tons.		1925. Tons.
Total Receipts, January 1st to December 29th	3,401,618	..	3,356,241
Deliveries ,, ,, ...	3,282,012	..	3,347,585
Meltings by Refiners ,, ,, ...	3,262,682	..	3,304,380
Exports of Refined ,, ,, ...	86,000	..	278,000
Importers' Stocks, December 29th	128,262	..	8,656
Total Stocks, December 29th	188,552	..	60,668
	1925.		1924.
Total Consumption for twelve months	5,510,060	..	4,854,479

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR,
1924, 1925, AND 1926.

(Tons of 2,240 lbs.)	1924 Tons.		1925 Tons		1926 Tons.
Exports	3,736,359	..	4,650,474	..	4,433,228
Stocks	145,422	..	292,119	..	225,593
	3,881,781		4,942,593		4,658,821
Local Consumption	115,000	..	135,000	..	145,000
Receipts at Ports to November 30th	3,996,781		5,077,593		4,803,821

Havana, November 30th, 1926. J. GUMA. – L. MEJER

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR TWELVE MONTHS ENDING DECEMBER 31ST, 1924, 1925, AND 1926.

IMPORTS	1924. Tons.	1925. Tons.	1926 Tons.
Refined......	595,254	762,648	699,480
Raw	1,159,486	1,352,451	1,068,983
Molasses ...	170,291	215,595 ..	152,808
	1,925,031	2,330,694	1,921,271

EXPORTS (Foreign).	1924. Tons		1925 Tons.		1926. Tons.
Refined.... ..	5,670	..	2,165	..	2,690
Raw.	11,199	..	743	..	1,212
Molasses	2,839	..	482	..	2,288
	19,708		3,390		6,190

HOME CONSUMPTION.

	1924. Tons.		1925. Tons.		1926. Tons.
Refined	566,838	..	673,563	..	696,463
Refined (in Bond) in the United Kingdom	868,400	..	876,950	..	788,022
Raw	127,899	..	112,305	..	143,978
Total of Sugar	1,563,137		1,662.818		1,628,463
Molasses	7,136	..	7,490	..	6,138
Molasses, manufactured (in Bond) in United Kingdom ..	60,793	..	59,453	..	65,432
	1,631,066		1,729,761		1,700,033

STOCKS IN BOND IN THE CUSTOMS WAREHOUSES OR ENTERED TO BE WAREHOUSED AT DECEMBER 31ST, 1926.

	1924. Tons		1925. Tons.		1926. Tons.
Refined in Bond	22,650	..	53,450	..	55,850
Foreign Refined	40,400	..	114,350	..	102,400
,, Unrefined..	92,850	..	247,500	..	176,650
	155,900		415,300		334,900

United Kingdom Monthly Sugar Report.

Our last report was dated the 8th December, 1926.

Throughout the last month the market generally has had a strong undertone; markets all over the world have been firm and prices, both for raws and refined, have advanced.

The London Terminal Market has continued to be active and the registrations—although slightly interfered with by the Christmas and New Year holidays—have been well maintained and a large volume of business has been transacted. Altogether about 35,000 tons were tendered in fulfilment of December contracts, but the vast part of the short account for this month was brought back, and in a good many cases transferred to March or May. Outside speculation has recently been making itself felt and March and May seem to be the favourite months. December was finally liquidated at 18s. 6d. January, which is a small month, has been traded in up to 18s. 10½d. and down to 18s. 6¾d., March has been in request and moved from 18s. 6¾d. to 18s. 11¼d. to 18s. 3d. to 19s. 6d. to 18s. 10½d. May moved from 18s. 9d. to 19s. 3d. to 18s. 6¾d. to 19s. 8¼d. to 19s. August moved from 18s. 6¾d. to 19s. 5¼d. to 18s. 7½d. to 19s. 8¼d. to 19s. ?d. There is not much disposition to trade in the new crop months and fluctuations were small. December moved from 17s. 5¼d. to 17s. 0¾d. to 17s. 4½d., whilst October sold from 17s. 9d. to 17s. 6d. to 18s. to 17s. 9d. The latest prices are January 18s. 6¾d., March 18s. 11¼d.; May 19s. 0¾d.; and August 19s. 3d.; December 17s. 4½d.

Trading in actual sugars has been in small volume owing to the trade holding off during the Christmas and New Year holidays. This lack of demand was accentuated by the usual stock taking which takes place in a good many cases at the end of the year. Ready Granulated has not been very plentiful and the price of Czechos has risen from 18s. 6d. to 19s. 6d., and Dutch to 19s. 9d. April/June and April/August is also scarce and business has been done at 19s. 6d. to 20s. 3d. Spot sugar shows a good improvement and the demand has been well maintained, considerably reducing the London stocks. Spot Granulated sold at 31s. 7½d. to 32s. 6d., the latest prices being 32s. 3d. duty paid.

Home Grown sugars have been sold up to 33s. 6d. and the latest price is 33s.

The British Refiners having found an increased difficulty in obtaining raw supplies have been obliged to adjust their prices accordingly. On December 8th their prices were advanced 3d. per cwt., a further 3d. on December 14th, and finally on January 4th another 3d. per cwt. Their latest prices are No. 1 Cubes 38s. 3d.; London Granulated 34s. 1½d.

Raws have been very sparingly offered. Cubans were sold at one moment at 16s. 3d. near at hand. Perus and Brazils sold at 16s. 6d. There were sellers to-day of February/March shipment at 16s. 3d.

In New York a fairly large business has been done in Cubans from 3¼ to 3½ cents. To-day's price is 3⅝ c.i.f. The Futures market is about 15 points higher than a month ago.

F. O. Licht has again reduced his estimate for Europe to 6,840,000 tons, showing a reduction of 650,000 tons on last year's crops.

On the 10th December the President of Cuba signed a decree limiting the present crop to 4,500,000 tons. This decree is definite and gives no loophole to increase the amount, but it is considered in well informed circles that should prices reach 4 cents and circumstances warrant such a drastic step, a further decree will be issued increasing the crop to 5,000,000 tons. The stocks at the end of the year were only 70,000 tons, and no new sugar is expected before the second week in January.

21, Mincing Lane,
London, E.C. 3.
January 11th, 1927.

Arthur B. Hodge,
Sugar Merchant and Broker.

THE

INTERNATIONAL

SUGAR JOURNAL.

☞ All communications to be addressed to "The International Sugar Journal," 2, St. Dunstan's Hill, London, E.C. 3.

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

No. 338. FEBRUARY, 1927. VOL. XXIX.

Notes and Comments.

The United States Consumption for 1926.

According to Messrs. WILLETT & GRAY, the consumption of sugar in the Continental United States for the year 1926 amounted to 5,671,335 long tons (expressed as refined sugar) which compares with 5,510,060 tons in 1925, and is thus equivalent to an increase of 161,275 tons or 2·93 per cent. This compares with an average annual increase over 104 years of 5·23 per cent. The *per capita* consumption for 1926 works out at 109·3 lbs. The 1926 figure of consumption is indeed the largest on record, having exceeded the previous largest, that of 1925. Only one other year—that of 1922—has exceeded the five million ton mark, and eight years ago the consumption was no more than 3,495,606 tons.

Of this amount of 5,671,335 tons, imports of foreign sugar and sugar from Hawaii, Porto Rico, and the Philippines amounted to 4,726,664 tons (of which Cuba accounted for 3,291,297 tons, Hawaii 618,098 tons, Porto Rico 459,684 tons, and the Philippines 312,723 tons); while the Louisiana cane crop yielded 70,259 tons, U.S. beet sugar accounted for 872,815 tons, and various sugars including maple added 1597 tons to the consumption. The amount of full duty paying sugars consumed was no more than 39,782 tons, and about three-quarters of this was refined cane sugar.

The apportionment of the refined sugar amongst the various producers gave 22·04 per cent. to the American Sugar Refining Co.'s establishments, 61·86 per cent. to the other U.S. refineries, 15·57 per cent. to the beet factories, and 0·53 per cent. to insular and foreign refined; while the raw and plantation sugars consumed amounted to 66,200 tons in all.

The average price of granulated sugar, net cash at New York, for the year was 5·47 cents, almost the same as for 1925, while the extreme limits paid were 6·125 and 4·9 cents. The corresponding figures for duty paid 96° centrifugals were 4·337 cents, 5·15 cents, and 3·96 cents. Finally, the average price of Cuba 96° centrifugals, c. and f. New York, was 2·568 cents.

The Minister of Agriculture on Beet Sugar Production.

Speaking at a recent meeting of the Council of Agriculture for England, Mr. GUINNESS, Minister of Agriculture, said the development of the new sugar industry had brought increased competition to the old-established industry of sugar refining, but this was only one of several world factors which had recently developed in an unfavourable way to the older industry. He hoped these difficulties were only temporary. Certainly from the agricultural point of view the beet sugar industry in this country had proved a very great success.

It was within his personal knowledge that this new opening had enabled a considerable number of farmers to make the difference between a loss and a reasonable profit on their operations. In 1927 it was estimated that there would be 174,000 acres under sugar beet, an advance of about 44,000 acres on last year. Fourteen factories had been operating in the present season, and they had the certainty that factories at Bardney and King's Lynn would be erected to take part in the industry next autumn. Three other factories would offer increased facilities; at Felstead, Spalding and Kidderminster they were doubling their resources.

Generally speaking, the results achieved by farmers had greatly improved in the current season as compared with last. The complete figures were not yet available, but one group of factories had so far got 17·4 as the average sugar content, against 16·36 last year. As to yield, he already knew that six factories showed an increase. There was still room for improvement, especially as regarded yield. He was hopeful that the improvement in the yield and in sugar content might enable the industry to adjust itself to the inevitable period of decreased prices which must come as the rate of subsidy declined and finally ceased.

The Sugar Resources of the British Empire.

Last month, Mr. BEN H. MORGAN, chairman of the British Empire Producers' Organization, read a paper before the Royal Society of Arts on the Sugar Resources of the British Empire. The following excerpts are amongst the more interesting features of his lecture.

The war, he pointed out, was a means of greatly increasing the competition of foreign sugars in this country largely because it gave America and her controlling interests a footing in Europe that had not been previously available. In fact, but for the fact that in 1920 the whole of the Mauritius crop was diverted to the United Kingdom, the hold secured by American sugar would have been still greater. As it was, this Mauritius supply enabled our Royal Commission for Sugar Supplies to stand out of the American market and bring down the world price. The lesson learnt, the way was the more easily paved for Imperial Preference.

The recent low prices for sugar have of course not helped matters, but the Empire producer thanks to the stabilized preference he gets of ½d. per lb. has been enabled to keep going, if not always at a profit, at least at a greatly reduced loss. Incidentally, Mr. MORGAN pointed out that the cost of production in Java and Cuba has been authoritatively put at about 3 cents per lb., while prices of sugar at their worst have been below 2½ cents. It is evident, then, that the ½d. preference has been of some assistance.

The low price that has prevailed of late months would at least appear to have increased consumption, and further progress in that direction might

be effected by carrying out suitable propaganda—the food value of sugar has never really been seriously exploited. In this connexion Mr. MORGAN emphasized that hitherto the British Empire has lagged far behind in the matter of organization. This is now to be remedied, as the sugar producers of the Empire are being organized to include every producing body of importance, and are about to form themselves into a sugar federation for the whole Empire with the object of co-ordinating the interests of all Empire sugar-producing and using interests.

The Scope for Increased Empire Production.

In the course of his paper, Mr. MORGAN ran through the various territories of the Empire and indicated their possibilities. In neither Mauritius nor the West Indian Islands is there much extra acreage available for sugar cane ; but British Guiana has large possibilities of expansion always provided it can get adequate supplies of labour. These must come from India, but so far the Indian Government has not encouraged the necessary emigration. South Africa might eventually produce a steady 100,000 tons of sugar for export to Great Britain. British East Africa is a new possibility. Here two classes of country are open to development : the river valleys near the coast, and the higher ground further inland where hardier varieties of cane like Uba can be grown. Three factories are already in successful operation in this territory, and if the sugar possibilities there were thoroughly examined by experts, it is believed that British East Africa could be made a great source of supply to the mother country within a few years.

Costs of Production.

Dealing with the scope for a further possible reduction in the costs of production of sugar, Mr. MORGAN pointed out that costs have been increased directly and indirectly by higher labour charges, but these can be more than balanced by organization, improved methods of manufacture, and the use of by-products. Money can be saved in the field by increased yield per acre and increased sugar content in the cane or beet ; mechanical efficiency is high already, but probably can become higher, especially by using cane-harvesting and beet-lifting machinery. There is a tendency with modern processes to make white sugar direct in the factory and save the re-melting and re-crystallization of the present refining process. The further use of cane refuse either for fuel, for making " Celotex " boards, or by the Classen catalytic process converting the cellulose content into glucose, which can then be converted into alcohol ; the full use of beet refuse for cattle food ; the use of molasses in the production of power alcohol—possibly the most important of all—are by no means highly enough developed. Industries in these days make their profits on what were waste products of former times, and sugar cannot afford any longer to be an exception to the rule.

The Durability of Old British Sugar Machinery.

Dr. C. A. BROWNE, the well-known American sugar chemist, and Chief of the Bureau of Chemistry, Washington, in a paper given before the Montreal section of the Society of Chemical Industry, remarked that one of the things that had always impressed him during occasional visits to tropical plantations was the wonderful durability of old British sugar-house machinery. He had seen in operation walking beam engines and other like appliances that had been in constant use for over 80 years. "Some held," he said,

"that the building of appliances to last for more than 20 years was an extravagance, as new and more economical devices which have by then been perfected should be installed in their place without further delay. Machinery built for a short existence has, however, the frequent defect of structural weakness, and the heavy over-burden which sugar-making equipment must sometimes bear demands the most durable kind of construction. This is particularly the case with sugar mills, which in grinding the new mosaic-resisting varieties of canes with high fibre content are subjected to enormous strains, far exceeding anything that the designers of those mills imagined possible."

The durability of old British mills is a well established fact; we gave an illustration in 1917 of an old Mirrlees mill in Cuba, built in 1851, which had had a life of about 65 years. And in those days when improvements were very gradual and mill equipment did not change radically in design for decades at a time, it was a very economical proceeding to purchase the most durable machinery. When the Americans first entered the sugar machinery market, they followed the usual engineering custom prevalent in their country of building to last a short period only; but in the last two decades they have learnt by experience that in sugar mill construction ability to withstand excessive stresses demands more durable qualities in the machines, and the best American practice has by now eliminated the earlier fault of too light a construction.

It may be assumed that the true criterion of good sugar milling plant is ability to stand up to any degree of overloading or other strains to which it is likely to be subjected in practice, and this condition fulfilled, it is not so essential nowadays that durability of existence *per se* should be aimed at. Improvements in design and scientific application have followed on one another rather rapidly of late years, and the design of one year may easily be rendered somewhat obsolete by that of a year or two later. This is particularly the case with the preliminary arrangements for preparing the cane for crushing in the mills, and quite a number of more or less successful devices have been tried out this century, and been added to or substituted for existing machinery. Progress of invention being more rapid nowadays, it may be postulated that ability to endure for a generation is a less desirable feature than formerly, and if it induces the owners of the plant in question to continue using it after it is relatively obsolete, there is an actual disadvantage. But ability to stand all strains and avoid all breakdowns is a very desirable feature, and it is obviously not possible to divorce this factor entirely from its complement of long life.

Farrel-Maxwell Mill-Shredder at Work in Cuba.

As our readers are aware, the principle of the Maxwell patent crusher-shredder can be applied to an existing mill if thought advisable, in which case it is termed a mill-shredder to distinguish it from the specially-designed unit called a crusher-shredder.[1] A Maxwell mill-shredder, made by the FARREL FOUNDRY & MACHINE COMPANY, of Ansonia, Connecticut (who have the licence to manufacture this machine for America and Latin America) has been installed at the Central Espana, Matanzas, Cuba, in time for operating the present crop, and started work on January 5th. We learn that both Dr. MAXWELL and Mr. FRANKLIN FARREL, Jr. (Vice-President of the Farrel firm) have been present from the start to supervise the operations. Dr. MAXWELL informs us that the first month's working has been most successful.

[1] See *I.S.J.*, 1926, 597.

The mill which is of the dimensions of 36 in. × 84 in. has been in operation since the start without any stoppage due to the shredder, and between January 5th and February 2nd shredded 70,000 tons of cane, during which operation only two teeth in the shredder were broken out of four hundred despite the frequent passage through of iron impediments. One set of teeth is expected to last the whole crop without sharpening or replacing. The speed of the shredder is 400 revs. per min., while the other two rollers are presumably running at 2 to 3 revs. per min. The horse-power required to drive the shredder is stated to be 70 to 80, and the hourly capacity of the mill is 130 tons of cane.

The data so far secured of the running of this new type of preparatory device[1] indicate that it is showing an improvement over existing methods as regards both capacity and extraction. Details are naturally not available at this early stage, but complete data will be published later on. In view of the big claims made for the Maxwell patent system of crusher-shredding and its possible influence on the economics of milling, it is not surprising to learn that the experiment now being made at Central Espana has led to great interest being evinced all over Cuba. This central though not in capacity amongst the first half dozen factories of Cuba is nevertheless one of the largest in the island, turning out last crop 64,561 long tons of sugar.

Recent Company Reports.

Amongst company reports connected with sugar that have been issued the last two months, we give the following by way of record : *Tate & Lyle, Ltd.*—The accounts of Messrs. TATE & LYLE, LTD., refiners, for the year ended last September showed the not inconsiderable fall in the net profits of £84,000, the amount being £459,505 as compared with £543,138 in 1925 and £616,784 in 1924. As a result the dividend was reduced from 13½ per cent. to 6 per cent. ; but £190,000 was added to the reserve as compared with £50,000 a year ago, and £52,018 was carried forward. Including this last sum, the Company now possesses reserves amounting to £1,333,700. Its issued share capital amounts to £4,412,000. *Mambre Sugar & Malt Co., Ltd.*—The report for the year ending last September of the MAMBRE SUGAR & MALT CO., gives the figures of profit for the last year prior to the recent amalgamation with Garton, Sons & Co. The profits were again favourable, amounting to £249,473, as compared with £210,708 in 1925. The ordinary dividend was 22½ per cent. as compared with 17½ per cent. a year previously ; £20,000 was placed to general reserve and £139,609 was carried forward. On the deferred shares, which are comparatively few in number, nearly 127 per cent. dividend was paid. The financial position of the Company shows all-round increased strength.

Ruth's steam accumulator is arousing not a little interest in the chemical industry of the U.K.[2] Some 260 plants of capacities varying from 300 to 120,000 lbs. of steam have been ordered. General advantages claimed are that the heating surface of the boilers may be increased by 10 to 60 per cent. ; and that there is a fuel saving of 15 to 30 per cent. Its installation enables the boiler plant in the average chemical works to be kept running at a steady steam output and pressure all the time, while the steam is being stored into the accumulator to be used as required. In an average works demanding steam fluctuations over wide limits the number of boilers might be five, but with the accumulator it should be possible to dispense with two of these.

[1] For full details of principle and design, see *I.S.J.*, 1925, 418.
[2] *I.S.J.*, 1924, 607.

Beet Sugar Notes.

The home beet sugar industry has attracted a good deal of attention of late in the provincial and county press of this country, and the farming community are being everywhere urged with increasing success to experience the advantages of including beets in their rota and send a supply to a nearby sugar factory.

As a rule the factories have done much better this year than last season. The weather has been more favourable, and the farmers have learnt the lesson of arranging economic delivery. One outstanding success has apparently been that of the new American-designed factory at Peterborough. Although working in its first year, it has announced a gross profit of £115,000 (out of which will have to come interest on loan, depreciation, preliminary expenses. and directors' fees). Over 60,000 tons of roots were worked up, and some 8000 tons of sugar turned out. The sugar content of the beets was very satisfactory, many deliveries having a content of 17 to 18 per cent.

The Cupar factory of the Anglo-Scottish group, another newcomer, dealt with about 19,000 tons of Scottish-grown roots; the sugar content averaged 17·9, but the tare was as high as 16·9, showing that the farmers lacked experience. Colwick, the principal factory of that group, turned over nearly 80,000 tons of roots, with an average content of 17·3 and a tare of 10·7.

Although the Anglo-Scottish group are not disposed at this moment to commit themselves to further factories, they are sufficiently encouraged by the results of this past season and the increased interest of the farmers to have the intention of enlarging the capacity of several of their factories. Thus Spalding is to be doubled in capacity for next season, Cupar will also be doubled if enough acres can be contracted for; and both Kidderminster and Felstead will increase their capacity considerably, the former to deal with 1200 tons instead of 800 tons of roots daily. This Anglo-Scottish group has now six factories in operation, viz., Colwick, Cupar, Felstead, Kidderminster, Poppleton and Spalding. Both Poppleton and Cupar have lately had a formal opening, performed however at the end of the campaign and not on the opening day. The Yorkshire factory will have an output for its first season of 8000 to 9000 tons of sugar, but in 1927 will have about double the 1926 acreage of roots.

Of other new factories which it is intended to have ready next Autumn, that at Selby, promoted by the Peterborough factory interests and of Dyer design, had got at least half the 4000 acres desired by the middle of last month and was prepared to start if 3000 acres was secured by January 31st; one projected at Bardney, Lincolnshire, under the auspices of a company called the Lincolnshire Beet Sugar Company, Ltd., is also to be of Dyer design, and will have an initial capacity of 1000 tons of beets, rising to 1400 tons per day. The Anglo-Dutch group are erecting an additional factory at King's Lynn, West Norfolk, to deal with 1200 tons of beets per day: the machinery for this is to be supplied by Fawcett, Preston & Co., Ltd., of Liverpool. So far no project for a factory in the southern counties has come to fruition; but farmers in Hampshire and West Sussex are increasingly interested in the experiments, and it seems only a question of a short while before they guarantee enough support to warrant the outlay on a factory.

Certain financial operations connected with beet factories have been effected recently. The Ely Beet Sugar Factory, Ltd., recently issued 200,000 shares of £1 each thereby completing its entire authorized capital

of £450,000; while the IPSWICH BEET SUGAR FACTORY, LTD., has similarly issued 150,000 shares of £1 each and so completed its authorized capital issue of £400,000. The whole of the above issue of 350,000 new shares has been taken up by the CENTRAL SUGAR COMPANY of Amsterdam, Mr. van Rossum's firm, which controls both the above factories. Application has been made to the London Stock Exchange for permission to deal in these shares. and they are now quoted in the official lists. The LINCOLNSHIRE BEET SUGAR COMPANY, LTD., which is erecting the Bardney factory, has made a public offer of 325,000 seven per cent. cumulative participating preference shares of £1 each at par; its issued capital will be £332,500, and it possesses a Government guaranteed advance of £225,000 under the Trade Facilities Acts on First Mortgage. This new company has a strong board of directors, including Mr. F. R. A. SHORTIS (an American banker), Mr. NORMAN MALCOLMSON (managing Director of the Trinidad Sugar Estates Ltd.) and Mr. W. J. BLANCHARD (Vice-President of the Dyer Company of America); and the issue was very extensively advertised in the financial and daily press. According to the prospectus, the company has entered into an agreement with the Société Générale des Industries Agricoles of Paris, whereby it secures the benefit of the services of highly-trained experts who will advise fully as to the methods of tilling, cleaning and manuring, and generally as to the best methods of cultivation, having in view the possibility of securing as large yields per acre as are now obtained by their extensive methods in Belgium. The technical management of this factory at Bardney will be entrusted to M. EMILE CHEVRON, who was for many years technical manager of the Sucrerie and Raffinerie Tirlmontoise, the largest beet sugar factory in Belgium.

Writing lately in the *Yorkshire Post* on agriculture in this country during 1926, Mr. C. S. ORWIN, of the Agricultural Economics Research Institute, Oxford, remarked that "perhaps the most notable event in arable farming during 1926 was the increase in the acreage devoted to the sugar beet crop. The official returns indicate an area of 125,000 acres, contrasted with 54,700 in 1925. So far as can be ascertained, the increase was made at the expense of the turnip and swede break, for both the mangold and the potato crops held their own. The districts now growing sugar beet are fairly widespread, and reports generally indicate the satisfaction of growers with the new crop. Experience in cultivation and handling is being rapidly acquired, the crop makes little or no demand on new capital, and under present conditions as to price the only factors limiting the increase of acreage are the capacity of the factories and the organization of seasonal labour. In districts of intensive farming, such as the potato growing districts, farmers and workers are accustomed to seasonal labour demands, and supplies are available as required. In other places rural dwellers are less accustomed to turn out for work in the fields at certain seasons of the year, but it is reasonable to suppose that a demand for workers at good rates of pay will not be long in creating a supply. 'If I could get the labour when I want it, I should grow nothing but sugar beet,' is the remark of one enthusiast.'

In a catalogue[1] dealing with colloid mills some figures are reproduced which give an idea of dimensions with which one may deal. Thus, 1 mm. is 1/25th of an inch; and 1 micron (μ) is 0·001 mm., or about 1/25,000, or 0·00003937 in. But the diam. of a colloid particle may be 0·01 micron, or 1/2,500,000 in. or 0·0000003937 in. The internal diam. of the holes of a 300-mesh sieve measure only 1/666 in. If it were possible to construct a wire sieve having 125,000 meshes to the lin. in., particles below 0·1 μ would pass through, and this is the size of quite a large colloid particle.

[1] Published by *Plauson's Mill and Filter-Press Ltd*, London.

The Raising of Seedling Canes in Java.[1]

(Continued from page 26.)

II.—Lines of Work and Technique.

Earliest crossing work.—During the campaign against *sereh*, trials were first made with various kinds of cane grown on the other islands of the Archipelago, but these proved to be either of too low yield or only partially resistant. Therefore crossing was commenced. Numbers were given to the seedlings selected, and a record was kept of them; and in 1897 these were marked by the added letters POJ (Proefstation Oost Java), and those obtained from 1903 onwards were included. In Table V, extending over 11 pages, Bannier gives the numbers and origin of all such seedlings as have been used in crossing work or were otherwise distinguished. Later, this series became official for Java as a whole, and seedlings raised in other parts were added. In a separate column, the seedlings still retained in the collection are indicated. From a careful study of this Table, a great deal of information can be obtained as to the direction, from time to time, of the line of work. Work done, previous to 1893, in raising cane seedlings was described in the *Archief* by Kobus in 1893, and this is not dealt with by Bannier.

In 1893, Wakker, the Director, was in charge of the seedling work. Free crossing was the rule, therefore the seedlings were either selfed or wind-fertilized. Certain definite crossings were however attempted, but did not lead to any permanent results: it is interesting, however, to note that Black Cheribon was crossed with Kassoer in that year. Among the wind-fertilized seedlings one of considerable value was, however, met with, namely 100 POJ. Years after, it became possible to suggest the parentage of this variety, and Jeswiet and Bremer, in 1916, published papers making it practically certain that 100 POJ arose from an accidental pollination of Bangjarmasin hitam by Loethers (a cane obtained from Mauritius by Wakker, according to Earle). From 1894 to 1896, free crossing continued and nothing important accrued, but, besides 100, 116 and 125 retained these numbers in the new POJ series. It was recognized that the chance of the best father meeting with the best mother was extremely remote by free wind-fertilization.

Ennobling of Chunnee.—In 1897 Kobus struck out a new line. It will be remembered that he visited North India for the collection of new types of sugar cane, on the chance of their being resistant to *sereh*; and brought over some 18 varieties, which he grew on the island of Banca, as a quarantine station. Of these he considered Ruckree and Chunnee to be the best, and transferred the latter to Pasoeroean in 1896. This cane was described as very thin and not long, extremely hard but with a good yield of sugar, very freely tillering and with high resistance to *sereh*. Botanically, Bannier states that these Indian canes have recently been described by Jeswiet, and given the position of a separate species, under the name *Saccharum Barberi*, to distinguish them from the ordinary tropical kinds known as *Saccharum officinarum*. Kobus began at once to cross Chunnee with tropical canes. The latter are termed "noble" in the paper, and seedlings obtained by crossing them with Chunnee are appropriately called "ennobled Chunnee." When the latter are again crossed with tropical canes, they are termed "twice ennobled Chunnee," and so on.

In this year, 1897, Kobus crossed Chunnee with Striped Preanger, and subsequently with Black Cheribon. On the whole, however, the former is

[1] De rietveredeling aan het suikerproefstation te Pasoeroean; Techniek, Richting en Resultaten van 1893-1925. J. P. Bannier. Mededeelingen van het proefstation, Jaargang 1926. No. 19.

now known as the better cross, in that it has the power to hand down better characters than Black Cheribon. This *direct crossing* of Chunnee with tropical canes continued till about 1912, and BANNIER therefore describes this as the "Chunnee Period."

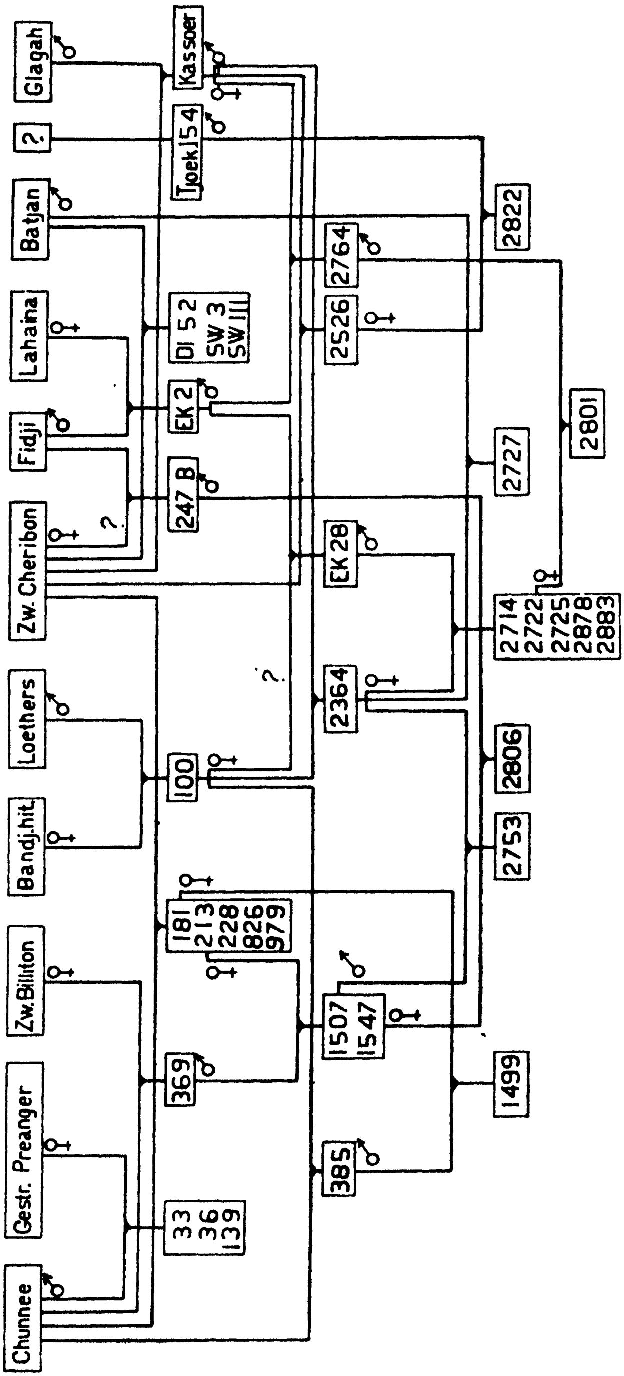
In 1898 and 1899 Chunnee was crossed exclusively with Black Cheribon, but, later, others were also used : this period of direct crossing lasting until 1905. The following additions to the POJ series were the result : 33, 36, 139 (1897) 213, 228 (1899), 826, 979 (1905). The full parentage of these and other of the more important POJ seedlings is given in the genealogical diagram on Table VII, which is reproduced in the present paper. The chief characters of these direct Chunnee seedlings are as follows : thin, moderate yield of sugar, definite hollow centre in the canes, resistant to *sereh*, strong root system and therefore very hardy, great tendency towards lodging, and very high susceptibility to mosaic (strepenziekte).

In 1905, the best direct Chunnee seedlings were crossed with one another, and the resulting seedlings are known as *derived Chunnee* descendants (afgeleide Chunnee nakomelingen). The best results were obtained in 1907, by crossing 213 POJ by 369 POJ and 385 POJ by 181 POJ, and the following were produced : 1499, 1507, and 1547 POJ. These were distinguished by having a better habit than the direct Chunnee seedlings, their sugar production was very good, there was less lodging (except in 1507), they were smaller, had a satisfactory to high weight of cane, but retained the susceptibility to mosaic. Because of this defect, and also the fact that, during the year in which they were distributed, better tropical canes were available, the derived seedlings exercised a less permanent effect on the industry than the former direct ones. Although they replaced the latter, and were more widely spread, they themselves were more quickly discarded.

Further ennobling of Chunnee has also been attempted, and among others the twice ennobled 2806 POJ was obtained by crossing 1547 POJ with 247 B. This seedling gives good production of sugar on good land, but rarely better than tropical canes. Thus, the ennobling of Chunnee has led to no permanent improvement in the canes of Java. After 1914, crossing with it rapidly declined, and at present Chunnee is never used, and its seedlings rarely and then only in combination with Kassoer blood. From this latter combination 2753 POJ was obtained, a form which unites the good characters of both ancestors, with the exception of the Chunnee susceptibility to mosaic. This seedling gives great returns on heavy, wet, clayey soil.

Breeding with tropical canes alone.—Before 1910, a number of crossings were made between tropical canes, but with little result ; and very few seedlings were added to the POJ collection. The Chunnee work was at this time considered to be more important, and still took by far the leading part in the yearly campaigns. Again, after the cessation of the latter, about 1912, and before Kassoer had attracted attention, for several years a great deal of work was done with tropical canes. The most various parents were used : Bandjarmasin hitam, Black Cheribon, Green German New Guinea, Batjan, Loethers, and many others. And, further, from 1913 to 1916, much selfing was tried among them.

Certain seedlings of good habit were produced, especially with Fiji and Green German New Guinea, but the production of sugar was low in most, and all of the better ones were far too susceptible to *sereh* and mosaic. Thus no permanent improvement was effected. Since resistance to disease still remained the chief desideratum, in later years crossing among tropical canes was carried on, rather for the furtherance of studies in the inheritance of



The Parentage of certain POJ kinds, and of the best known other Java Seedlings.

characters in the sugar cane, than for the production of useful commercial varieties.

The ennobling of Kassoer.—This cane has given better results than Chunnee. For long the nature of Kassoer was uncertain, and at first it was regarded as a distinct kind, strong in its growth and resistance to disease. For this reason, as has already been noted, it was crossed with a tropical cane in 1893 ; and this was repeated in 1907, 1908 and 1909. But the low percentage of sugar in the seedlings, even when crossed with rich canes, led to its being discarded. In the latter three years, Glagah (*Saccharum spontaneum*), was also thus crossed, but the results were unsatisfactory. In 1911, Kassoer was, however, again tried by WILBRINK, when it was crossed with both Black Cheribon and 100 POJ. Out of the great number of seedlings obtained, some 200 were added to the POJ collection. These were, as before, strong in rooting and growth, and resistant to *sereh* and mosaic, but all of them had little sugar.

About 1915, JESWIET was able to throw fresh light upon the nature of Kassoer, and the causes of its previous failures to satisfy. This was the result of a careful study of the morphological characters of *Saccharum spontaneum, Saccharum officinarum* and Kassoer ; and he came to the conclusion that Kassoer was probably the result of a chance hybridization between these two species. And this assumption was strengthened in 1917 by crossing Glagah direct with a seedling of Black Cheribon × Fiji : the resulting seedlings, 2772, 2775 and 2776 POJ, were in all their characters very similar to Kassoer, and could indeed safely be described as "self-made Kassoers" (eingemaakte Kassoers). BREMER, in 1922, added confirmation, by a study of the numbers of chromosomes in the two supposed parents and in Kassoer itself. Kassoer can thus be regarded as an ennobled Glagah or *Saccharum spontaneum*. The latter has little juice and nearly no sugar, Kassoer has sugar and distinctly more sap. Crosses between Kassoer and tropical canes (twice ennobled Glagah) have better appearance and higher sugar, coupled with strong root growth and resistance to disease.

When the true nature of Kassoer had been determined, an impetus was given to its further ennobling, and this took the place of the crossing between tropical canes in the annual programme. In 1916, various Kassoer seedlings obtained by WILBRINK in 1911 were crossed with EK 28, but the results were not a great success. In 1917, however, attention was attracted to another of these seedlings, 2364 POJ (100 POJ × K). It had very good habit, was erect, sufficiently thick and very long jointed, had robust growth, a strong root system and a good leafy crown, and its sugar content was better than that of its congeners. But its most important character was its capacity for handing down its good qualities to its offspring, which is frequently not the case with good cane varieties. Of many other seedlings of this series, tried in 1917, 2364 POJ has proved to be easily the best.

It was crossed with 2571 POJ, 2592 POJ, EK 28 and Batjan, and a number of its seedlings were added to the POJ collection in 1918 to 1919. Crossed, as mother, with EK 28, it gave among others 2714, 2722 and 2725 POJ ; and with Batjan, 2727 POJ. These twice ennobled Kassoer (thrice ennobled Glagah) have the robust growth, strong root system, and complete or partial resistance of Glagah, with sufficient sugar and the good habit of the tropical fathers, grand and great-grand parents. The sugar content of some was very good. Their productivity, especially in good light soil, was not very high, and they required much water. On clayey soils, especially such as were not of the best quality, 2727 POJ became prominent, while 2722

and 2725 required much water and early planting. The POJ collection thus reached a higher level with Kassoer than with Chunnee, and after 1924 the area planted with POJ seedlings distinctly increased.

From 1917 onwards the same line of work was continued. Many variants were tested in the crossing, but 2364 POJ × E K 28 consistently gave the best results. From this cross arose, in 1921, the seedlings 2878 and 2883 POJ, which surpassed the 1917 three (2714, 2722 and 2725 POJ). The best of the latter plants flower very freely and consequently soon become pithy, whereas 2878 POJ flowers very little, which is a great advantage, has high sugar and great weight of cane, and is very slightly affected by mosaic. POJ 2883 gives somewhat less sugar, flowers more and is very susceptible to mosaic. Every year hundreds of seedlings are raised, in the hope of obtaining better ones. New possibilities may arise, chiefly by way of other tropical parents, with as high sugar as possible, and especially the power to pass on their characters. The increase in resistance is not now of so much importance, as this is thought to be fully guarded by Kassoer.

Apart from this work with 2364 POJ, many other seedlings of the same parentage have been tried, as well as Glagah itself with the idea of obtaining a better basal cane than Kassoer. A certain amount of thrice ennobling of Kassoer (four time ennobling Glagah) has also been attempted, and for this work the best mothers appear to be 2722 and 2875 POJ. The percentages, in the batches of seedlings, with good sugar was higher, but the average resistance less. Hence the resistance to disease occupies an important position, again, in the selection of these seedlings with attenuated Kassoer blood. Lastly, besides tropical canes with high sugar content and low resistance, Kassoer seedlings are being crossed with such kinds as Green German New Guinea, Fiji, Sampang A, and Sawoe Kroepoek, forms which have greater resistance to disease and very good habit, but are comparatively low in sugar. As might be expected, in the batches of seedlings obtained, higher resistance is met with, but the sugar content is low ; and the chance of obtaining the desired forms is accordingly less, although the method is considered worthy of further trial.

Ennobling Saccharum sinense.—During recent years, a good deal of crossing has been done with this class of canes, which are extensively grown in China, Formosa, British India, and in many other places. The best known are Tek-cha, Puri, Uba, Zwinga, Kavangire and Cayana. The main characteristics of these canes are : low weights of cane, reasonably good sugar, strong root system, and resistance to *sereh* : their susceptibility to mosaic varies in the forms studied, but is certainly less than was formerly thought. There are some hopes entertained that by crossing these some results of value may be obtained, but the success along this line is at present small. Kavangire appears to be the best for crossing purposes.

The inheritance of characters in the sugar cane.—Unfortunately, next to nothing is known in this matter, and this is put down by the author to the complicated hybridization of the cultivated sugar canes. But some of the results obtained during the long study of seedlings at Pasoeroean are considered to be worth recording. In the first place, BANNIER is very careful in guarding against the assumption, which he states is met with among some workers in cane breeding, that the different parents pass on their characters in equal degree. Thus, it is wholly erroneous to imagine that, in a cross between Glagah and a tropical cane, half of the seedlings will resemble each parent, or that in thrice ennobled Glagah the proportion would be one-eighth to seven-eighths. As a matter of fact, when Glagah is crossed with

a tropical cane, very many seedlings of the batch differ little from it, others are intermediate, while very few show any strong likeness to the tropical parent. All kinds of cane exhibit very great variations among their offspring, and certain kinds transmit their own characters much more strongly than others : and, since a great number of parents have been used in crossing for many years at Pasoeroean, certain conclusions have been arrived at in this respect. Some of these are given in the following pages, and it is thought that the information given will be of use as a guide in deciding on the year's crossing programme. BANNIER's list is here summarized, as useful information is given regarding the behaviour on crossing of a large number of well known canes.

100 POJ[1]: very few seedlings are obtained in the batches with this cane as mother, and usually with poor habit : these flower heavily, and the sugar is low, and very seldom even reasonably good. Therefore 100 POJ is not used for the production of commercial canes, but rather for the study of others which are also early flowering and male fertile.

2194 POJ : usually flowers heavily and very early : it is tall, and this character is handed on to its few descendants : they generally have a very good habit, but little thickness : internally very solid, but with many cracks and low sugar. Therefore 2194 POJ is seldom used for crossing.

2354 POJ : like 2364 POJ, this cane is pre-eminent as a disease resistant mother of Kassoer origin : its seedlings inherit its thinness : neat in habit and not very free flowering, like the parent : sugar usually sufficient, but the chief defect is the low weight of cane.

2364 POJ : used in a great number of combinations during the last ten years, passing almost all of its good characters on : the number of seedlings is usually small, but more when raised at Malang. The most desirable characters of the seedlings are : moderate thickness (greater than in the parent), sufficient to very good length, long, straight joints, strong root system and almost always good sugar. The defects are heavy flowering and consequent pithiness, and these characters should be specially noted in selection. The best male parents for this cane, thus far, are EK 28 and SW 111.

2722 POJ : often used as mother plant of thrice ennobled Glagah. In the seedlings the canes are long and very heavy, but with the thickened nodes of the parent, and thus have a less handsome appearance : amount of flowering very variable, and usually solid stemmed. Crossed with all possible tropical parents, the seedlings have sufficient to very high sugar content.

2725 POJ : there are many descendants from this mother, but with very few good characters : often rough and with nodes thickened : flowering very heavily and quickly becoming pithy, and sugar only moderate : buds stand out and easily start shooting.

2780 POJ : used regularly as mother during recent years, because the descendants usually have good form. They have long and very heavy canes, but joints a little zigzag ; flowering small, but a distinct hollow in the stem : sugar very variable. As 2780 POJ is itself low in sugar, it should only be crossed with rich canes.

2802 POJ : seedlings stand out because of their neat appearance : straight and cylindrical and with little flowering : sugar sufficient to good. The great defect is thinness, therefore best crossed with thick fathers, prefer-

[1] In these short descriptions, the writer found it difficult to get at the exact meaning of some of the words, e g., knokig (bony), grof (coarse), beschaafd (polished). The first two are not usually applied to sugar canes; and in the present paper the three words are translated "with thickened nodes," "rough," and "neat," respectively.

ably with high sugar, such as Bandjarmasin hitam, Preanger, and Soerat Banteng.

2806 POJ : this seedling hands down the typical characters of its Chunnee ancestor, good sugar, great susceptibility to mosaic, and pithiness, to its seedlings. Their appearance is usually good : thicker and heavier than 2806 POJ itself : joints zigzag, and frequent cracks and protruding root eyes : flowering consistently heavy, and the tendency for the mother shoot, to develop more rapidly than the tillers, strongly inherited. This seedling is only used in crossing with Kassoer in order to increase the resistance to mosaic.

2822 POJ : flowers heavily and for a long time, therefore much used as a father because of its fertile anthers, and producing large batches of seedlings if the mother offers no hindrance. The inheritance of characters in the seedlings is very variable : they have moderate sugar, sometimes very low or very high : similarly with the amount of flowering and pithiness : form often good, straight and very thick, but sometimes with enlarged nodes : the violet colour of the father often seen in seedlings.

2836 POJ : used in very many crossings as mother, as it is very thick, with good length and handsome appearance—characters which are found in many of its seedlings, but, with this habit, they also inherit low sugar content. All of these characters are inherited from Ardjoeno, a cane which hands them down strongly, and thus 2836 POJ is unsuited for crossing.

2853 POJ : from a cross between a "self-made Kassoer" and Striped Preanger. For a grandchild of Glagah it is surprisingly thick, and this character is freely passed on to its seedlings : in these, the joints are often swollen and deformed, and the canes crooked and weak (slap), besides which, the tillering is poor. The sugar content is, however, for a thrice ennobled Glagah, very high ; and for this reason the seedling, which is sometimes male fertile and sometimes not, is much used in crossing.

2875 POJ : of great value in crossing work : its own characters are not so good as those of 2878 and 2883 POJ, but it transmits better characters to its seedlings than these do. The habit of the seedlings is often very fine (mooi), while the thickness and length of the canes are sufficient : usually long jointed, but flowering occurs in some : sugar mostly good. The number of seedlings in the batches is uniformly high.

2883 POJ : batches small, even when crossed with fertile fathers : the few descendants are usually rough and deformed : flowering is variable and the sugar is not high : very often pithy, although 2883 POJ itself appears solid enough.

2887 POJ : A valued mother, usually producing large batches of seedlings. In these there is great variability, some being very poor and some with very good habit : thickness usually sufficient, but tops often suffering from pithiness: sugar also very variable, but good juice not infrequent. The seedling certainly has good characters, which may be handed down to its descendants.

2914 POJ : attracts attention because of its abnormally long and handsome, upright canes, which are found in many of its descendants : but their canes have small thickness and low sugar. Therefore this seedling is unsuited for crossing purposes.

247 B : greatly used as father in early years, but with small permanent result : seedlings often rough, and very heavily flowering : the zigzag canes and many cracks are also handed down : sugar very variable, but rarely high. The percentage of good seedlings with 247 B as father is small in the batches.

DI 52 : usually with little fertile pollen, and when used as mother results never good, while when selfed the seedlings usually misformed dwarfs. In

later years it has been found that, when grown at Malang, fertile pollen is produced, and therefore it has been tried as father. The results at present are few, but it already appears that the good sugar of the parent is transmitted to the offspring, which also have a very good habit.

EK 2 : not well suited for crossing, because of the deformed character of the canes and the projecting buds, transmitted by the father. Plants with splits, also, often met with in the batches of seedlings : sugar variable, but may be very high sometimes : the bad habit is. however, a serious defect.

EK 28 : one of the most useful among the fathers : fertility of the pollen often very low, but greater at Malang, hence large batches in this place. EK 28 often transmits a good habit, yet the number of worthless seedlings is large : sugar is usually good, but heavy flowering is met with, and is a defect : late ripening is also handed down.

SW 3 : as with SW 111, only suited for crossing with thick mothers : thinness a character of very many of its seedlings, and sometimes unevenness added. Yet the habit is not bad : length of cane is usually sufficient and the joint formation often better than in the parent (see Batjan at the end). Sometimes the canes are weak : flowering varies, but does not occur in very many : sugar is not bad, but good juice is, nevertheless rare.

SW 111 : practically as SW 3, but certain results better : seedlings also thin, but of good habit, and usually straight and long-jointed : flowering, however, copious : sugar not bad and sometimes very good, and early ripening seen in many. For this reason SW 111 is readily used in crossing.

Bandjarmasin hitam : flowering rare at Pasoeroean and little pollen, but both better at Malang : fertility very high there at the beginning of the season, but very low towards the end. So this kind can be used as father or as mother : its thickness very strongly inherited, often with good sugar : habit however, rough : eyes stand out strongly, and canes are often dry in centre : batches usually small.

Black Cheribon : much used in early years, but chiefly with Chunnee and its descendants : the characters of the latter strongly dominate in the seedlings, and therefore little is known about the inheritance in Black Cheribon. The fertility of its pollen very low or nil at Pasoeroean, but moderately high at Malang, especially in the beginning of the flowering season : it was generally used as mother, and then large batches obtained. In the seedlings the variability of the characters of the female parent great : habit not bad, and so with sugar ; but in all respects Black Cheribon is less useful than Preanger.

Preanger : fertility of pollen practically as in Bandjarmasin hitam, and batches not large : habit very neat : canes not very long, but joints well formed : sugar varies a great deal, but sometimes very satisfactorily high. This variety transmits its good qualities better than other original canes.

Ardjoeno : characters referred to under 2836 POJ : decendants have thick and heavy canes, and short and swollen joints : plants rough and often very weak, but percentage of seedlings with good habit high : sugar specially low : flowering not very heavy.

Green German New Guinea, Sampang A and Sawoe Kroepoek : related to one another, and similar as to transmission of characters to descendants. These have good habit, but moderate to very low sugar is seen in many seedlings : canes usually very thick, straight and cylindrical : length sufficient : flowering very variable : buds usually flat on stem. Sampang A stands out in some combinations, in others the remaining two, but the batches with Sampang A as father are largest. When these canes are used for fourth ennobling of Glagah, some plants are found with very satisfactory sugar.

Lahaina : much valued as mother : flowering little in the plains, but better at Malang. The cane only to be used in the green variant, as the chlorophyll-free places on the stem are continued into the inflorescence; many ovaries are without chlorophyll, and give colourless seedlings which soon die. Transmission of high sugar is very strong, but so is that of the weak roots, and the susceptibility to *sereh* and mosaic. In the seedlings, cane habit heavy, but sometimes rough and crooked or weak : joints often short and deformed, and root eyes quickly protruding : flowering rare. Because of high sugar content Lahaina is desirable in crossing.

Loethers : stands out because of the high sugar in its descendants : habit usually not very good (mooi) : canes moderately thick, but weak, rough and zigzag : many plants have pointed and sprouting buds : heavy flowering largely transmitted, with thin tops and much pithiness. Sometimes the habit is distinctly better, and therefore Loethers occupies an enviable position in crossing.

Fiji : to a certain degree comparable with the Green German New Guinea group : its good habits found in many seedlings : canes usually very long and thick, but with zigzag joints : eyes sometimes much swollen and cracks not rare. When used as father large batches are obtained, in which the seedlings are heavy and have little flowering. The transmission of good habit is perhaps less than in the group above mentioned, but that of high sugar is greater. This is not high in Fiji itself, and even less in the seedlings, but those with sufficient sugar are not rare.

Batjan : as in Lahaina the striped form is not used, and for the same reason. Habit and sugar content largely transmitted, the canes being consistently very thin, often weak, but very long : many show the peculiar swelling joints of Batjan. Flowering variable, and many with the same susceptibility to disease as the parent : sugar content well transmitted, mostly good and sometimes high. As father, Batjan comes a little behind its descendants S and especially SW 111. For this cane to be of use it must be crossed with thick mothers.

III.—Summary of the Results obtained, 1893-1925.

This portion of BANNIER's paper is devoted to the details of the crossing work during the whole period, and these are presented in tabular form. The Tables are preceded by short statements concerning them, but it will suffice, in the absence of the Tables themselves, merely to refer to the nature of the matter dealt with.

Table I gives, for each year, the numbers of arrows sown, combinations of parents, combinations used for the first time, successful ones, i.e., where at least ten seedlings were obtained, and seedlings planted out. The totals for the whole period were : 6884 arrows sown, 2825 different combinations used, and 392,871 seedlings planted out. Table II gives, for the period 1912-1925, an analysis of the same details for each year, separating artificial crosses from those obtained by wind or selfing. In Table III, the combinations of parents are grouped into ten divisions as follows : tropical canes only, ennobling Chunnee, twice ennobling Chunnee, thrice ennobling Chunnee, twice ennobling Glagah, thrice ennobling Glagah, four times ennobling Glagah, combinations between ennobled Chunnee and ennobled Glagah, Saccharum sinense, and others.

Table IV gives the details of the various combinations used in each year, and the results obtained in each combination : numbers of arrows harvested, seedlings planted out, selected at the end of the first year, at the end of the

second year, and at the end of the third year, i.e., added to the POJ collection. This Table, of course, covers many pages (62), and practically forms a diary, year by year, of the crossing work of the Pasoeroean station. Table V has already been referred to, as containing details of the complete POJ collection, with their immediate parentage, and those which are still in the collection at Pasoeroean. Table VI contains curves of the various combinations for the whole period : tropical canes only, Chunnee ennobling, Glagah ennobling, and others. In the latter, are included combinations between Chunnee and Glagah seedlings, the ennobling of *Saccharum sinense*, and again others : this curve is nowhere high. The diagram gives a clear idea of the stage of development at any period. Thus, in 1925, the crossing programme included about 75 per cent. of Glagah ennobling, 8 per cent. of crosses between tropical canes only, and 17 per cent. of " others," as defined above. This proportion has been practically unaltered since 1918, although a small amount of Chunnee crossing was done at intervals.

C. A. B.

Notes on some British West Indian Sugar Crops of 1926.

By Sir FRANCIS WATTS, K.C.M.G., D.Sc.

As during recent years appreciable efforts have been made to increase the output of sugar in the British West Indies by attention to the cultivation of the crop, by the use of new and improved varieties of canes, and by the employment of up-to-date machinery, it may be of interest to review briefly the results of reaping the crop of 1926 in the principal islands.

Trinidad.

The crop reaped in Trinidad in 1926 was 73,561 tons ; this quantity has only once been exceeded, namely, in 1887, when 79,010 tons were produced. From the returns available it appears that the crop of 1926 was made from 742,881 tons of canes, of which 384,002 tons are reported as having been grown on the plantations belonging to the factories, while 358,881 tons were purchased from cane farmers. The production of canes for the factories by cane farmers is a striking feature of the industry in Trinidad ; nearly one-half of the sugar produced in the island is so grown, the cultivation being carried on for the most part by peasants who individually cultivate very small areas. On the average 10·1 tons of canes were taken to make one ton of sugar, the amount varying considerably in the different factories ; in the best equipped factory it was as low as 9·55 tons.

For purposes of comparison it may be recorded that the output of sugar from the island during the past 21 years has been as follows :—

Year	Tons.	Year.	Tons	Year	Tons.
1926	73,561	1919	47,850	1912	40,936
1925	69,629	1918	45,526	1911	46,718
1924	52,045	1917	70,891	1910	51,950
1923	41,619	1916	64,231	1909	52,972
1922	59,948	1915	58,882	1908	48,933
1921	54,933	1914	55,488	1907	50,564
1920	58,416	1913	42,331	1906	62,975

Several causes contributed to the increased output in 1926. In the first place the early part of the growing season was, on the whole, favourable ; during the latter part, including the reaping season, the weather was how-

ever unusually dry and much difficulty was experienced for want of water, there being a pronounced shortage of drinking water both for the peasantry and for the working stock. Towards the latter part of 1925 extensive outbreaks of froghopper pest occurred in various parts of the cane growing area, being worst in the districts between Caroni and Brechin Castle, the middle section of the cane growing area.[1] At one time it was feared that the crops of some of the estates in this district would practically be destroyed, but matters improved somewhat towards the close of the year ; nevertheless it is estimated that the crop was reduced by some 60,000 tons of canes on the large estates, exclusive of the losses experienced by the cane farmers, which must have been considerable. It may be estimated that by the ravages of this pest the crop of the island was reduced by somewhere in the neighbourhood of 10,000 or 12,000 tons of sugar ; it would seem, therefore, that some reason should be assigned for the crop being above, rather than below, the average. Some of the increase is probably due to the greater attention paid to cultivation and the growing of more suitable varieties of canes, while a slight increase comes from the larger output of farmers' canes ; but there is another source of increased supply that deserves mention. Owing to the low price of cacao, the cacao trees over considerable areas have been cut down and the land planted to sugar cane ; at the same time certain new areas have been opened up and planted with sugar canes. Thus a considerable area of new land was brought under cane cultivation. About two and a half per cent. of the increase, or some 2000 tons of sugar, appears to have been derived from increased extraction of sugar from the canes, due, it may be claimed to the better working of the factories rather than to any improvement in the quality of the canes themselves, for, as will be stated later, the drought and the froghopper pest tended to lower the quality of the canes and rendered the making of sugar difficult at times.

The sugar crop at Trinidad is made in 12 factories, whose output during the past season ranged from 960 to 29,365 tons of sugar. Much attention has been given in recent years to the improvement of the machinery in the majority of these factories, until now the work of the largest, the Usine Ste. Madeleine, compares favourably with that of the large and up-to-date factories of Cuba, Porto Rico and Java, and is not far behind that of the best Hawaiian factories. It sets a local standard to which other factories are endeavouring to approximate. In this connexion the following abstract of the work done by this factory and by five others may be of interest.

Crop reaped in 1926.	Ste. M.	A.	B.	C.	D.	E.
Tons cane per ton sugar	9·55	9·85	10·78	9·51	11·36	10·70
Cane—Sucrose per cent.	12·27	12·24	11·72	12·24	11·95	—
„ Fibre „	14·64	12·33	15·54	12·25	—	—
Bagasse—Sucrose per cent.	2·11	3·70	3·98	3·84	—	—
„ Fibre „	48·84	44·82	45·61	47·23	—	45·97
„ Moisture „	47·22	49·67	49·12	46·41	—	52·63
Sucrose in juice per 100 Sucrose in cane	94·95	91·68	89·72	—	84·08	84·93
Sucrose in sugar per 100 sucrose in juice	88·42	86·90	84·16	81·88	83·51	77·21
Coml. sugar per 100 sucrose in juice	92·22	90·52	87·82	—	—	—
Coml. sugar per 100 sucrose in cane	87·47	83·01	79·10	85·81	—	—
Purity final molasses	32·18	31·34	37·32	29·84	—	—

The mills at the Ste. Madeleine factory are equipped with revolving cane knives and with Searby shredders, in addition to "crusher" rolls followed by four sets of 3-roller mills.

[1] See *I.S.J.*, 1925, p. 585; 1926, p 78.

These six factories turned out 75 per cent. of the island's crop in 1926 and thus fairly represent the general work of the colony.

Owing to the drought which occurred towards the end of the growing season and the injury done to the canes by the attacks of froghoppers, the purity of the juice at many of the factories fell off to a marked extent towards the close of the grinding season, and at times difficulty was experienced in the manufacturing processes. This is a point to be borne in mind when considering the above figures. The impaired condition of the juice led to an increase in the ash constituents of the juice which further increased the difficulties of manufacture.

During the year 1925-26 most of the estates gave much attention to the cultivation of their canes, and it may fairly be claimed that steady improvement has resulted; the canes are now, on the whole, kept much freer from weeds than was formerly the case, and better cultivation and draining are evident. Special attention has been given to the use of implements and motor tractors in the work of cultivation; steam ploughing and harrowing are largely practised, and extensive use is made of motor tractors, particularly on the estates of the Ste. Madeleine Company. This Company has found the Holt tractors suitable for a good deal of its work, but experience shows that for the cultivation of the heavy land it is necessary to have recourse to the 10-ton tractors, for much of the land is too heavy to be successfully handled by the 5-ton type. Recently a 60 h.p. Best tractor, made by the amalgamated Holt and Best Companies, has been introduced with satisfactory results.

Extensive experiments have been undertaken with various cultivating implements, including the Killifer types of sub-soilers, knifers and cultivators, while graders are being used to advantage.

Enquiry is made for a motor-hauled implement for forming the deep drains which are necessary for the removal of the storm water and the aeration of the land; up to the present the ideal implement has not been found, but the search is being further prosecuted.

It is worth noting that questions relating to the best methods of cultivating and handling the soil are now receiving much intelligent attention in Trinidad, and there is a prospect of good results accruing in the way of increased crops and reduced costs.

Much attention is also being given to the increased production of farmyard manure and the growing of cover crops to keep down the weeds and to serve as green dressings. Experiments are in progress in the production of farmyard manure from the use of bush and roughage, together with cane tops, by the Adco process; and a very considerable quantity of farmyard manure is also being made by what is known as the Mauritius process, which consists in giving a limited number of cattle a far larger quantity of fodder and roughage than is demanded by their actual food requirements, the object being to make use of the bacteria of their excreta to cause the decomposition of a relatively large quantity of material. The fodder and roughage is cut up by means of appropriate chaff-cutters and fed to the animals in large quantities and after being under the animals for a short time this material including their droppings is stored in large pits, under cover, where fermentation rapidly takes place, care being taken to maintain the proper moisture of the heaps by the addition of water, if necessary. By this method the quantity of farmyard manure produced by a given number of animals can be increased four or five-fold and the resulting manure

is of excellent quality. It is anticipated that this method will help to solve some of the problems of manuring and maintaining in good tilth the heavy lands on which much of the cane crop is grown. The importance of this in Trinidad is considerable, for here reliance is placed on the successful production of ratoons, which necessitates the maintenance of the soil in a good state of tilth.

Attention is being directed to the question of finding the most suitable variety of cane for cultivation in the island ; there appears to be a consensus of opinion that the variety BH 10·12 is, on the whole, the most usefu variety so far available. It grows well both as plants and ratoons, the juice being rich in sucrose and of good purity. The variety SC 12·4 is also attracting favourable attention and is likely to be grown on a considerable scale. Uba cane is extensively grown on poor lands in order to meet the difficulties which they present : it is thought that the use of this cane may enable such land to be brought into such better order as to permit, in the near future, of the cultivation on them of canes of better type. Uba cane suffers from the disability that it does not shed its trash and, as it is a thin cane growing in dense clumps, it is not possible to cut it until the trash has been got rid of by burning. It is a fibrous cane from which the juice is not readily extracted, but this difficulty has been to a large extent overcome by the use of Searby and other kinds of shredders and the use of an adequate quantity of maceration water. The cultivation of Uba cane on the part of cane-farmers is discouraged. There are certain thin canes of a similar hardy character to the Uba which have the advantage that they shed their trash ; these are being experimented with in the hope that they may prove as useful as Uba for the special purpose of dealing with difficult land, and, at the same time, may be cut without burning.

BARBADOS.

The sugar crop of Barbados in 1926 is given in returns provisionally obtained as :—

Sugar	46,856	tons.
Fancy molasses	62,647	puncheons
Choice molasses	6,393	puncheons

A crop not differing markedly in quantity from that of the previous year. The weather conditions were not entirely favourable for the production of a large crop, for, while the rainfall of the latter half of 1925 was good, the early part of 1926 was extremely dry, the reaping season from February to June being one of the driest on record. In consequence of this the return of the juice from the canes and the purity of the juice were below normal, so that in many cases the number of tons of cane taken to make a ton of sugar was higher than it should have been, though this was not uniformly the case.

A striking feature of the sugar industry of Barbados is the manufacture of a considerable portion of the crop into syrup, as will be seen from the figures relating to the crop given above. This feature exercises a marked influence on the industry. In some instances this syrup is manufactured in the boiling houses, or factories, adapted to the muscovado process, to which are attached mills of low power (for the most part 3-roller sets only, often driven by windmills) and consequently effecting but poor recovery of juice. In other instances syrup is made at the factories where 6 or 8-roller sets of mills are in operation.

The factories, in addition to grinding canes from the estates with which they are associated, purchase the canes from neighbouring estates the owners

of which are guided in their determination to sell by the prospects of the market for syrup ; consequently the factories, in order to obtain a full supply of cane, are obliged to offer the highest possible prices, for if what is thought to be too low a price is offered for the canes the owner has the alternative of converting them into syrup.

The sugar crop of Barbados is manufactured in a number of factories of comparatively small size. The following figures taken from the returns of two of the best equipped of these factories will permit of comparison being made with the work of factories in other islands :—

	Factory A	Factory B.
Total sugar made	4283 tons	3412 tons
Tons cane per ton sugar	8·52	8·88
Canes—Sucrose per cent.	13·26	13·63
,, Fibre ,,	14·10	12·48
Bagasse—Sucrose per cent.	2·41	5·08
,, Fibre ,,	51·13	44·84
,, Moisture ,,	45·84	48·59
Sucrose in juice per 100 sucrose in cane	94·99	89·59
,, sugar ,, ,, juice	87·68	88·19
Coml. sugar 96° ,, ,, juice	93·18	91·82
,, ,, ,, ,, cane	88·50	82·33
Purity final molasses	36·93	30·17

Factory A is equipped with a pair of splitting, or crushing rolls followed by four 3-roller sets of mills and is thus a 14-roller mill ; in addition there is a set of cane knives at the top of the cane carrier. Factory B has a pair of splitting rolls followed by two 3-roller sets of mills, thus being an 8-roller mill.

Owing to the high state of cultivation in which the fields are maintained, the quality of the canes grown in the colony is good ; this is enhanced by two factors, the selection of good varieties of canes from amongst the many raised locally, and the fact that over a large part of the island there is little or no ratooning, so that the mills are supplied with an unusually large proportion of plant canes.

The agriculture of Barbados is of a mixed character to a larger extent than is generally recognized, there being a large production of other crops, mainly food crops, including yams, sweet potatoes, eddoes and maize, while fodder crops, including Guinea corn, Imphee and others, are extensively grown. This diversification of agriculture is undoubtedly beneficial and helps to maintain the excellence of the agriculture of the island.

During the year the Agricultural Department of the Colony was reorganised, elaborate preparations being made for the creation of a Sugar Experiment Station on a large scale with a view to extending the work of producing new seedling canes ; in the course of this work special consideration is to be given to the production of seedling canes of known parentage. Questions concerning the cultural requirements are also to be extensively investigated.

(*To be Continued.*)

" Scientific research is as old as humanity.[1] Its inception is the physical satisfaction of human curiosity. Its ultimate object is that the living plane of mankind may be raised, and that the world's natural resources, mankind's heritage, may be conserved. Those charged with the control of industries to-day are responsible that their industry by research shall add its mite to human progress and to material conservation."

[1] Published in *Oil Power*.

Japan's Sugar Trade.

By WALTER BUCHLER.

The comparative shortage of sugar which it is predicted in many circles will make itself felt about the middle of this year is partly due to the demand from the Far East. Inquiries have come from China and Japan, and a regular business has developed with those markets in Continental refined sugar. Japan was the first in the Orient to take to sugar on as large a scale as in Europe, and her population consumes more sugar than China does in proportion. To take one example where sugar plays the most important part, nowhere in the East are there more sweet-shops, more confectioners than there are in Japan ; the habit of eating sweets, both among young and old, is universal throughout Japan ; and with her ever-growing population the consumption of sugar is bound to increase still more rapidly in that country than in other parts of the Far East. Japan depends for her supply of sugar on Formosa (Taiwan) and Java. As in other essential industries, she seeks to become independent of foreign sources of supply other than her own colonies. Thus, it is not surprising to find Japan doing her utmost to extend the cultivation of sugar cane and, where more suitable, sugar beet throughout her Empire. Sugar cane is cultivated in the islands of Okinawa and Oshima (south of Hondo) ; every effort is being made to promote the sugar beet industry in the Hokkaido (northern section of Japan), in Korea, Kwantung Province, and Manchuria ; but her greatest success has, so far, been in her colony of Formosa.

The total local production in Japan proper is about 40,000 tons annually. Every encouragement is given by the Japanese Government to private enterprise, to increase the output and areas of plantations, particularly in the Hokkaido, where there are at present four companies with a total capital of £3,000,000 engaged in growing beet. The difficulties of selecting the right location combined with the heavy rains at harvesting time are still questions requiring a solution, before the Hokkaido can become an important sugar-producing centre for Japan. The working capacity of these Companies in the Hokkaido totals 2300 tons, and 90 tons of refined sugar.

Korea which is trying to build up a beet sugar industry still imports most of her sugar from Japan proper, Formosa, and Java. There is only one important refinery (Pyengyang sugar refinery), which enjoys practically a monopoly. Considerable progress has also been made by the South Manchurian Sugar Refining Co., Ltd., established at Mukden. There is no doubt that it is but a matter of time before the production of sugar in Manchuria will become as important a factor as the sugar cane industry in Formosa. Particulars of Japanese enterprise in this part of China were given in a previous article.

Not satisfied with the steady progress achieved by her endeavours to become independent of foreign sources for supplies of sugar, Japan has recently established sugar mills in Java, Sumatra, and other South Sea Islands, with the view to encouraging private industry and to encourage emigration. Her chief concern, however, is Formosa, whose industry is bound up with that of Japan, and is, therefore, being here taken together. The following table shows Japan's imports of sugar for six years :—

	1921.	1922.	1923	1924.	1925.	1926 Jan./May.
	£	£	£	£	£	£
Brown sugar	6,490,000	5,952,004	4,800,000	6,400,000	7,508,000	2,663,000
Refined sugar	492,000	409,300	400,000	—	—	—

Japan's Sugar Trade.

The following countries participated in this trade for 1924 :—

	£		£
China	17,600	Philippine Islands....	393,100
D.E.I.	5,950,000	U.S.A.	2,600
Hongkong	21,500	Others	15,200
			£6,400,0000

The cane sugar from the Philippine Islands is of a poor quality, and is mostly used for direct consumption in Japan in a raw state. The Japanese are not particular about the kind of sugar they use, as long as it is cheap and sweet. There is a large consumption of a dark brown sugar prepared from the juice in a primitive manner, which is much lower in price than ordinary refined. Most of this quality is made from sugar cane cultivated in Japan proper and from that imported from Formosa, practically her entire production being shipped to Japan, as the following figures show :—

Area and Production of Cane Sugar in Formosa.

	Acres		Tons.
1924......................	275,730	..	472,000
1925......................	260,993	..	479,000

	Shipped to Japan. Tons		Value		Other Countries. Tons		Value.
1924..	425,000	..	£12,000,000	..	25,130	..	£602,000
1925..	426,791	..	£10,565,000	..			

The decrease in area planted with sugar cane in Formosa was due to the hesitation on the part of farmers between growing sugar or rice, high prices being obtainable for the latter and less risk run in growing it. Formosa has also developed a profitable export trade in fruits, which is often of greater advantage to the agriculturist than is sugar cane. Still the output is well maintained, though the acreage under sugar cane tends to decrease as the price for rice rises. But it is evident that, were it not for the powerful Government patronage and the preferential treatment accorded to Formosan sugar in Japan, sugar would take a secondary place in her export trade, instead of being the largest item, as at present. There are 167 mills and refineries in Formosa, 44 of which are of the latest style, 13 improved, and 104 old-fashioned. The principal Companies controlling Formosa's sugar industry number 14 with an aggregate capital of £16,500.000. and these control the 44 modern plants. Their combined capacity of production of various qualities of sugar varies between 570/600,000 tons, and the kinds of sugar produced are as follows : Low grades, 85 per cent. ; raw, 7 per cent. ; refined, 6½ per cent. ; molasses, 2½ per cent.

Formosa imports on an average 23.000 tons yearly from abroad, chiefly from Java, the figures for 1925 being : 21,165 tons, value £458,456. This sugar is used for refining locally. The cheaper grades of Formosan sugar are exported to China, where quality matters still less than it does in Japan, lowness in price being the only consideration. Although the majority of the principal Formosan sugar factories are Japanese, plantations are not under their control. Hence the difficulty of inducing farmers to cultivate sugar cane when they see better and surer prospects in rice-growing. The subsidy granted to Formosan sugar planters did help to solve matters, which is not surprising when, up to the year 1923, it amounted to £1,241,820. Quality is a more important question than acreage. This the Japanese Government realizes and through its Sugar Bureau established at Tainan carefully watches the progress of the industry. The result has been a decided improvement in the quality of Formosan sugar. At one time it used to be

a brown concrete sugar used only for direct consumption and not suitable for refining. The tendency in Formosa is that in the course of time more and more sugar will be refined in the island. Thus, as Formosa turns out more and more crystal sugar, a greater proportion of it is being refined, which means a gradual decrease in the importation of Java sugar. In this connexion, Formosa's imports of Java sugar are of interest :—

	£		£
1920	1,110,000	1923	444,000
1921	537,000	1924	384,000
1922	610,000	1925	458,456

It is, however, unlikely that Formosa will for a long time, if ever, be in a position to dispense with supplies from Java, on these grounds ; the average yield per acre is smaller than it is in Java and the Formosan cane has a lower sugar percentage. These drawbacks are due to irrigation in Formosa being inferior ; to plantations not being left in fallow systematically as in Java ; and the productive capacity is often abused ; also, wages are higher in Formosa than in Java (10d. against 6d.). The only remedy is improved methods of plantation and increase in acreage. Formosa enjoys protection to a very large extent in having an assured market and price for her sugar in Japan besides a subsidy in the shape of a preferential duty. The present duty on sugar is levied in full on sugar imported for direct consumption. If the sugar is refined in Japan and used for local consumption in Japan, there is a refund.[1] All sugar consumed in Japan is liable to a "Consumption" or "Excise" tax,[2] which has made this commodity very expensive in comparison with prices in other countries. The wholesale price for refined sugar in Tokyo averaged for the past six months £2 per cwt., and the retail price 5d. per lb. The consumption tax yielded £7,010,000[3] in 1925 and is expected to yield £7,500,000 in 1926. High prices locally have enabled Japanese refiners to make profits from 100 per cent. to 200 per cent. On the other hand, their joint retrenchment to maintain prices has not always been successful owing to slackening of exports, slump in prices occasioned by the growth of the world's output, the consequent increase in supply, besides a simultaneous increase in domestic production. In spite of the increase in consumption, recent years have not been entirely profitable to Japanese refineries ; the sugar market in the latter part of 1925 was considered the worst, and it is

[1] Sugar drawback or refund—

	Rate of drawback.
(1). Refined sugar, cube sugar, loaf sugar, and similar sugar—	
(a) Under No. 11 Dutch standard ..	Yen 2·50 per 133⅓ lbs.
(b) " 15 " " ..	3 10 " "
(c) " 18 " " ..	3·35 " "
(2). Rock candy sugar—	
(a) Under No. 11 " " ..	1 90 " "
(b) " 15 " " ..	2·40 " "
(c) " 18 " " ..	2·60 " "
(d) " 21 " " ..	3·30 " "
(e) at or above 21 " " ..	3·60 " "

[2] Sugar Excise—

Class 1.	Under No. 11 Dutch standard..	Yen 2 to yen 3 per 133⅓ lbs.
" 2	" 15 " " ..	5·00 "
" 3	" 18 " " ..	7·00 "
" 4	" 21 " " ..	8 00 "
" 5	above 21 " " ..	9·00 "
" 6	Sugar candy, lump sugar, etc...	10·00 "
	Molasses	2·00/3·00 "
	Syrup	8 00

[3] Sugar Excise—

1914	£2,338,000	1919	£4,616,000	1923	£6,475,000
1915	£2.267,000	1920	£4,039,000	1924	£8,020.000
1916	£2,744,000	1921	£5,496,000	1925	£7,010,000
1917	£2,982,000	1922	£7,290,000	1926	£7,500,100
1918	£3,635,000				

estimated that in 1925 they sustained a loss of more than £2,000,000, this being due to loss on forward contracts. High home prices enable Japanese refiners to supply export markets at competitive prices, which without this sort of assistance they would hardly be able to do. Japan's trade in sugar in China, particularly in the Yangtze Valley, is considerable. Her exports there of refined sugar during the last 16 years were the following :—

	£		£		£
1910 ..	610,000	1916..	1,640,000	1922..	1,910,000
1911 ..	679,000	1917..	2,615,000	1923..	1,474,000
1912 ..	848,000	1918..	2,325,000	1924..	2,900,000
1913 ..	1,600,000	1919..	2,162,000	1925..	3,214,000
1914 ..	1,230,000	1920..	3,059,000	1926..	1,975,000
1915 ..	1,180,000	1921..	1,580,000		(Jan./August)

Most of the refined sugar Japan exports is shipped to China ; boycotts which the Chinese use as an effective weapon when wishing to show their displeasure with one nation or another—and Japan is more often than not the one against whom the Chinese have, ever since the "21 Demands" organized boycotts—do not affect sales of such staple commodities as sugar, as they bear no marks. The following table shows the destinations and quantities of refined sugar exported by Japan during the first half of 1925 and 1926 ; also for the whole of 1923, 1924, and 1925 :—

FIRST SIX MONTHS.

	1926 Tons	1926 Value £	1925 Tons	1925 Value £	1924 Tons.	1924 Value £
China	62,784	1,320,000	50,902	1,213,000	47,710	1,228,000
Kwantung	4,700	97,000	5,058	123,000	2,118	59,000
Asiatic Russia....	696	14,246	—	—	8	333,000
Other countries ..	50	1,088	140	35,420	—	—
Total	68,230	1,432,334	56,100	1,375,420	49,836	1,620,000

12 MONTHS

	1925 Tons	1925 Value £	1924 Tons.	1924 Value £	1923. Tons.	1923. Value £
China	129,455	2,929,730	105,890	2,733,634	58,458	1,368,000
Kwantung	11,306	214,617	5,880	158,530	3,896	88,190
Asiatic Russia....	1,234	26,468	194	6,803	13	356
Others	140	3,185	50	1,033	780	17,454
Total	142,145	3,214,000	112,044	2,900,000	63,147	1,474,000

Japan's refining industry has made considerable progress. There are now thirteen refineries in Japan proper, run by seven Companies which between them possess a paid-up capital of £14,500,000, The principal ones are : Dai Nippon Sugar Refining Co., Ltd., 5 mills : Taiwan Sugar Refining Co., Ltd., 2 mills : Meiji Sugar Refining Co., Ltd., 2 mills. The meximum production of these 13 mills, working on an average of 300 days in the year, is now 489,000 tons. The largest of the oversea buyers for Japanese refineries are the Mitsui Bussan Kaisha, Suzuki & Co., Ltd., and Mitsubishi Shoji Kaisha, all of which have offices in London, New York, and in most capitals.

In conclusion, it would be just as well to watch Japan's activities ; merchants should not overlook the Japanese market when making offers, as it is worth catering for, and is an ever-growing consumer of sugar.

Direct Current Variable Speed Electric Drives for Mills, and their Advantages.

By WILLIAM P. ABENDROTH, E.E., Associate A.I.E.E., New York.

In the November, 1926, issue of this Journal[1] Mr. L. B. WHITAKER, A.M.I.E.E., of Jamaica, called attention to the rather casual way in which the use of electricity has developed in the raw sugar industry, with particular reference to the driving of the mills. We agree with Mr. WHITAKER in much of his comment. Our experience shows that the development of the electrification of the grinding mill has been the adaptation of standard apparatus as used in other industries, rather than the thoughtful development of a system for the exclusive use of driving sugar mills. This fact was true, also, of the earlier applications of electric drive to all other industries.

The subject of correct engineering has received thoughtful study by many of the sugar mill engineers, many of whom feel that the location and sporadic financial depressions of the sugar industry have been the reasons for the large electrical companies of the world not closely following the matter.

It is rapidly being brought to the front in several sugar-producing countries of the world, that the efficiency of the grinding, both in regard to capacity and extraction, is a function of the individual mills, For this reason, the necessity of a reliable drive, having easily adjustable speed characteristics, has recently come into prominence.

It is true that variable speed may be obtained with the use of A.C. motors, but only by considerable loss of efficiency either in secondary resisters of wound rotor motors, or in reduction of speed of steam turbines when operating on varying frequency. Alternating current motors have been developed for special purposes, but these motors are not applicable to the sugar mill. The A.C. motor of the brush shifting type is not suitable for the heavy loads and slow speeds required by the sugar mill, and further the range of satisfactory speed variation is limited. The single field cascade motor type of control is only applicable when the motors divide the load mechanically, as for example, in railway locomotives, or two motors on a single stand of rolls. If the motors do not divide the load equally, they will not operate satisfactorily. It is a well-known fact that each of the mills in a train of a cane-grinding unit has its own individual characteristics, due to roller surface, settings and fittings. Consequently, this application is unsuited for the service.

With all of the above in mind, engineers concerned naturally turned to direct current; and this is not a retrograde step. The D.C. motor is coming into wider use each year, for it is inherently a motor whose speed may be adjusted without material loss or much trouble. At the present time, D.C. is replacing A.C. in passenger elevator service, mine hoists, machine tools, ship control, steel mills, rubber factories, and particularly in the paper industry. All of these applications have been brought about on account of the inherent ease of speed control, with the retention of relatively high efficiencies. All industries requiring adjustable speed motor drive are seriously looking towards the D.C. motor as the only means of obtaining the desired results.

As to power generation, it is just as easy to obtain D.C. by use of turbines, as it is A.C. The high speed turbine, geared to a moderate speed

[1] Page 602.

D.C. generator, is common practice in all industries. The advantages of the high speed turbine and the slow speed commutator are thus maintained. The modern generated tooth type of reduction gear is a proved and highly efficient mechanism which will give no trouble. D.C. and A.C. generators have been successfully coupled to the same turbine, so this offers no problem. One of the largest power houses in New York is at present driving through a high pressure turbine the main A.C. generator, the house auxiliary generator, and two exciters. The result is extreme simplicity as to steam and electrical control. If necessary, the A.C. and D.C. systems may be tied together by means of a motor generator, but this is unlikely to be required.

The cost of copper is a small item in the milling plant. The labour costs of wiring are generally in excess of the cost of copper. The labour item will vary almost directly with the number of conductors. Hence the labour charges for 2-wire D.C. will be approximately two-thirds of that for 3-phase A.C. With identical A.C. and D.C. voltages, the actual cost of copper and labour for wiring will be approximately the same, but providing 600-volts D.C. is used versus 440-volts, 3-phase A.C., then the former will actually be cheaper than the latter. As to the relation of copper costs versus motor generators, why use a motor generator with an efficiency of approximately 85 per cent.. when the copper losses may be less than 5 per cent. ; and further, why add the motor required to drive the D.C. generator ?

Mr. Whitaker mentions that there are many methods for correcting the power factor. We know of only two methods, namely, the synchronous condenser and the static condenser. The question of economic value of power factor correction will usually only apply to the uncorrected power factor less than 85 per cent., and usually it does not enter into a properly designed system where the induction motors are of medium sizes, have relatively high speeds, and are fully loaded. These motors will have a power factor of between 85 and 92 per cent. at full load, and 80 to 91 per cent. at three-quarter load ; and may be corrected, if required, by a moderate installation of static condensers. In many cases, power factor correction cannot be economically justified if the motors are properly applied.

Standard turbines generally have their most efficient operating point at 80 per cent. of rated load. Occasionally, the most efficient point is at full load rating. Would it not be better to have only one prime mover supply all power requirements to a factory, and have this unit properly designed to operate at its most economical point rather than have a multiplicity of units at varying loads and frequencies with varying steam economies ? In turbine capacities of such sizes as are in general use in sugar factories, a large unit, even if partially loaded, will have as good, or better, economy than a small unit carrying the same load.

It will be found that by proper design and layout of the sugar factory, taking into account location of boilers, boiling house and generator house, an arrangement may be made which will result in very high steam economy when using the all-electric system of drive. Practically all of the steam will go directly through the turbines and to the boiling house. The steam will be without oil. The piping is simple. The use of various steam engines complicates the piping, and, of necessity, there is oil in the exhaust.

In view of information received by the writer from some of the sugar producing countries, notably Java and Hawaii, it is evident that individual drive of the mills is warranted. This drive makes possible the flexibility to grind at rates which will give greatest capacity with maximum extraction.

Therefore, with all of the foregoing in mind, the D.C. drive was selected and then developed to its present high state of efficiency, adaptability and flexibility for the sugar mill.

Mr. Whitaker's remarks were very pertinent, timely, and to the point. They serve to illustrate opinions probably held by many engineers. We are grateful that he has given us the opportunity to present this discussion on behalf of the use of direct current.

Content of Fusel Oil and Etherial Salts in Demerara Rum.

By MAURICE BIRD B S.

During a recent discussion at a special meeting of the Jamaica Imperial Association, Rum and Sugar Committee, anent the stabilizing of Jamaica rum prices, the statement was made, that, by the omission of certain acids, it is possible to get a rum near to Demerara rum without the decided flavour of Jamaica rum. In this connexion it should be of interest to record some experiences that throw considerable light on the constitution of Demerara rum as affecting the consumer.

About 15 years ago the NEW COLONIAL CO., since in liquidation, requested me to go into the separation of fusel oil, as a by-product in the manufacture of rum, as they were offered a good price for all they could produce. But to my surprise I could find little more than a trace of fusel oil that had been formed during the fermentation of the "wash" used to make rum. At first I thought that this was due to deficient laboratory methods of testing, but subsequently most up-to-date methods with the use of special apparatus failed to detect the presence of appreciable quantities of this constituent. Later, in discussing the matter with the late Sir JOHN HARRISON, he told me that owing to the high temperatures in Demerara, and the consequent rapid fermentation, little or no fusel oil could be expected to form, though in Jamaica, with its cooler climate, the fermentation was slower and appreciable quantities of fusel oil were produced in the manufacture of rum.

Again, it was formerly believed that an unadulterated Demerara rum would always contain 50, or more, parts of etherial salts (esters) per 100,000 parts of alcohol; but, having occasion some years ago to examine large quantities of rum, produced in various parts of this Colony, in respect of this constituent, I found the bulk of it to contain less than 50 parts of ethers per 100,000 of alcohol, and my results were endorsed by those of other chemists.

Since there can be little doubt that a high ether content is injurious to health, and that fusel oil must be considered as, at least, a mild poison, I would offer the suggestion that the comparatively low content of the former, and the almost total absence of the latter, in Demerara rum indicates a spirit of peculiar purity and freedom from obnoxious ingredients, as it comes from the still.

"Plasmochin" (Bayer & Co.), the new malaria remedy is believed to operate on the parasites on the same principle as salvarsan, and is estimated to be ten times more effective than quinine.[1] Reports which have come to London on this remedy from the West Indies and elsewhere are very favourable, cures of persistent forms of the disease having been testified.

[1] *I.S.J.*, 1926, 11.

Nanji's Paper Pulp Process.

Attention is directed to a process of great possible interest in the sugar industry for the production of paper pulp from bagasse and certain other waste vegetable materials. It is the result of researches carried out by Dr. D. R. NANJI, M.Sc., F.I.C., until recently Lecturer in the Department of Biochemistry of the University of Birmingham, and author of several papers which have been noticed in our columns.[1]

Dr. NANJI points out that this process differs in principle from the methods hitherto proposed for the production of paper pulp from such material as bagasse and found impossible of economic operation. In the processes of digesting the bagasse hitherto attempted for the production of a pulp from bagasse suitable for manufacturing paper, coloured substances formed during heating. These stained the pulp, which in consequence became very difficult and costly to bleach commercially. But in the new process the formation of such colouring matter is avoided, a different principle being adopted in the digestion of the pulp from the crude material. As the result, it is found that the process promised to develop into a technically successful proposition.

The process is one of general applicability, and requires only one hour for the complete resolution of the cellulose material compared with 4 to 20 hours' digestion as in present-day methods. Yield of the dry pulp is 40 per cent. of the weight of the air-dry bagasse, its minimum market value being estimated to be £16 to £20 per ton.

A bagasse pulp is now produced which is very white, and extremely strong. It forms tough, dense sheets with a good rattle. Experts have confidently expressed the opinion that the pulp would be suitable by itself for the manufacture of best grades, as notepaper, but that it would probably find its most important application as an addition to mechanical wood pulp for the production of newspaper.

Dr. NANJI has filed patents in the United Kingdom and every cane sugar-producing country in the world. His invention appears to be a proposition of particular value in those countries which have an excess of bagasse awaiting profitable utilization. The proposal is that estates should sell their residue to a local organization operating a central factory for the production of the "half-stuff" during the inter-crop, this unbleached material being shipped to the mainland for finishing in pulp factories. Alternatively, however it might be found more practicable to bleach the half-stuff on the spot, shipping this product directly to paper factories in London. New York, or other centres

This proposition may have some bearing on the production of alcohol in cane growing countries. It is argued by some that in certain countries the proposition to produce fuel alcohol directly from cane juice may be an economical one especially where there is over-production of cane. If such a scheme appears feasible it should be more so in conjunction with a process such as Dr. Nanji's for economically utilizing the by-product bagasse obtained in the crushing.[2]

The largest beet molasses desugarizing plant in the world is situated at Johnstown, Colorado, this belonging to the G. W. Sugar Company. Its rated capacity is 100 tons of molasses per day, or 250,000 bags (25,000,000 lbs.) of white granulated sugar per annum. About 140 men will be employed throughout the year. The "refinery" is almost completely electrified.

[1] *I.S.J.*, 1921, 644; 1922, 216, 439, 608; 1925, 52, 390; 1926, 617

[2] Those desirous of looking into the process can obtain samples, cost data and other particulars by writing to: The Sugar Manufacturers' Supply Co., Ltd., 2, St. Dunstan's Hill, London, E.C.3.

Uniformity of Methods in Sugar Beet Analysis.

By A. W. LING, B Sc., N D.A. (University of Bristol).

Probably no agricultural crop has been taken up by farmers in this country with so much enthusiasm as sugar beet, and from comparatively small localized areas in the Eastern Counties the growing of beet has spread rapidly westwards. It was formerly thought that beet growing could only be carried out with a reasonable degree of success in those parts of this country where conditions of soil and climate approximate nearest to those found on the Continent, but with the gradual increase of the acreage of land under this crop in the West of England it has been found that sugar beet will grow equally as well, if not better, where wetter and warmer conditions prevail.

This increase in the acreage of land under beet has naturally led to many analyses of beet being made annually. Analysis of sugar beet is not confined to factory chemists, for many other chemists, such as those whose duty it is to advise farmers as to the best manurial treatment of their crops, and those responsible for experimental work, as well also as research workers, have to undertake tests of this type. In view of this large band of workers in one common field, it appears essential that uniformity of methods in sampling and analysis should be observed amongst those concerned in order that the results may be comparable.

In the past many different methods of sampling and analysis have been used with the result that grave discrepancies have been discovered when one set of figures has been compared with another, both obtained from the same field or same sample of beet. It is realized that differences in sugar content are possible in what appear to be precisely similar batches of beet, as there are so many factors operating; but these errors can, to a very large extent, be eliminated if similar methods of sampling are adopted and the analytical technique is strictly standardized.

Sugar beet sampling and examination naturally falls under three headings: (1) Field sampling—from experimental plots, etc.; (2) laboratory sampling, and (3) sugar estimation.

(1) Field Sampling.

It is not an uncommon occurrence to receive at the laboratory three or four roots for sugar determination, as representative of a whole field. Such a proposition is, of course, useless and it is recommended that where a representative sample of beet is required from a field or experimental plot, the field or plot be sampled at regular intervals, every *N*th beet being taken, the minimum being 25 roots, the position of the *N*th to be left to the individual concerned. Whilst a minimum of 25 is suggested, obviously a larger number is much more desirable, but this is not always possible owing to high freightages, etc. The roots for sugar determination should be sent to the laboratory in exactly the same condition as they are sent to the factory, namely "topped," and as clean as possible.

(2) Laboratory Sampling.

On arrival at the laboratory the percentage of dirt is determined by the usual method of washing and weighing. In order to obtain the sample of pulp or "brie" for the sugar determination, the whole of the 25 roots should be used. It is a common practice in some places to pick out 10 or even less beets for this purpose, but one rather doubts the accuracy of this

method ; in fact, as in the case of field sampling, 25 are recommended as a minimum and where possible 50 should be used.

The quickest, cleanest and most accurate way of obtaining the pulp is by means of a rapidly revolving (1000 r.p.m.) circular saw of about 1/16th in. in thickness, driven so that it is rotating away from the beet and not towards it. The crown of the beet is presented to the saw, which is run through the centre of the beet lengthwise from crown to tail, the resulting fine powder pulp being collected in a hopper underneath the saw. Each of the 25 beets should be treated in this way so that a composite sample is obtained in the hopper below.

In some laboratories, for a number of reasons, the circular saw method is not practicable, and in these cases the following method is recommended : The beet is cut in half lengthwise, and a thin slice is pared off the exposed surface of one half ; the slice is minced up as finely as possible in an ordinary mincing machine, the whole batch of beet in the sample being treated in this manner whereby the composite sample of pulp is obtained. It must, however, be pointed out with this method that the pulp is very much coarser than that obtained by the circular saw, and that in consequence it is necessary to adopt different means for extracting the sucrose in the pulp. Where the pulp has been obtained by the circular saw method the Krüger cold water extraction process has been found to give quite accurate results, whereas with the coarser pulp complete extraction by this method is not an easy matter, for which reason the Pellet hot water process is advised.

(3) Sugar Estimation.

(*a*) *Kruger cold water process* (to be used in conjunction with the circular saw method for obtaining the pulp).—This method is fully described in "A Handbook of Sugar Analysis," by C. A. Browne, and briefly is as follows : The pulp is transferred from the hopper of the saw to a beaker and thoroughly mixed by stirring for a minute. Approximately 26 grms. of the mixed pulp are weighed out on counter-poised "onion" papers. (The exact quantity of pulp to take depends upon the calibration of the Krüger pipette in use and this must be determined by previous trial.) The pulp and paper are placed in the metal capsule or beaker, and roughly 3 c.c. to every 1 grm. of pulp (i.e., 78 c.c.) of dilute lead sub-acetate solution—7 to 9 volumes of water and 1 volume of lead acetate—are added by means of the automatic pipette. After mixing the pulp and "lead water" the beaker is allowed to stand for at least 20 mins. with repeated stirring. Then the contents of the beaker are finally stirred, filtered and polarized in a 200 mm. tube.

(*b*) *Pellet hot water process* (to be used always where the pulp is coarse).—This process is also described in detail in Browne's "Handbook," the general details of the method being : Thoroughly mix by stirring the composite sample of pulp. Weigh out 26 grms. of the mixed material and transfer by washing into a Kohlrausch wide mouth flask graduated at 200·6 c.c. Add sufficient lead sub-acetate solution (5 to 7 c.c.) until no further precipitate appears by the "streak" method, aiming to avoid an excess of the solution. Fill the flask to within an inch of the mark with hot water, and immerse it in a water-bath at from 80-85° C. for half an hour, shaking during this period at intervals to disengage the air bubbles.

At the end of half an hour remove the flask from the water-bath, and allow it to cool down to a standard temperature of 20° C. Add a few drops of ether to break the foam, complete the volume ; mix thoroughly,

and filter. If the filtrate is not clear, a drop of glacial acetic acid may be added to clarify. Polarize in a 200 mm. tube at 20° C. and multiply the reading so obtained by 2 for the percentage of sucrose in the beet.

In conclusion, it may be added that the above methods have now been adopted by the Agricultural Education Association through its Sugar Beet Analysis Sub-Committee, of which the writer is Convener.

Conferences on the Cultivation and Manuring of Sugar Beet.

LORD CLINTON acted as Chairman at a conference at the Rothamsted Experimental Station on the growing of sugar beet and the RIGHT. HON. E. G. PRETYMAN at one taking place at Ipswich, under the auspices of the Suffolk branches of the N.F.U., the Suffolk Chamber of Agriculture, and the Agricultural Committee of the County Council. Following is a summary of the most important contributions made by speakers.

ROTHAMSTED.

Mr. J. M. VAN BOMMEL VAN VLOTEN, of Holland, remarked that seed trials had shown not only the quality of the varieties tested, but the percentage of bolters and the suitability of certain varieties for certain soils. Other series of experiments dealing with the spacing of rows indicated definitely that narrow spacing (the rows separated by no more than 14 or 16 ins., plants 8 ins. apart, and eight plants to the sq. yd.) gave the highest yield. It followed that the English practice of spacing rows about 24 ins. apart was wasteful; the larger individual plants that resulted had a lowered sugar-content, while the yield, both of roots and of sugar, per acre was below the maximum. The speaker emphasized that whereas the farmer's aim was a high yield of sugar per acre, manufacturing costs were least with a high-quality beet, not only because a greater weight of sugar was obtained from a given quantity of roots, but because the impurities of low-quality beet hindered the extraction and refining of the sugar. For this reason, and since the farmer would normally try by heavy manuring to grow a large crop at the expense of quality, it was worth the factory's while to offer a better rate for the higher percentages of sugar. Yet in England the farmer received 54s. per ton for a 15·5 per cent. sugar content (3s. 4d. for each percentage unit), and only 2s.6d. extra for each additional per cent. of sugar.

Mr. T. G. FOWLER, commercial manager of Cantley factory, remarked that it was to the factory's advantage to raise the quality of the beet and make growing profitable to the farmer, by offering reliable information and reserving the right to supply seed of known value. The farmer for his part could do a great deal to assist the factory in maintaining regular, efficient running at full capacity, keeping to the terms of his contract instead of delivering all his beet at the time when it contained most sugar. In his experience, suppliers were far too careless in gathering the roots and cleaning them before delivery. Badly topped roots which would sprout in store, with consequent loss of sugar, weeds and "bolters" that would choke the slicing knives, and stones, to the extent in his factory alone of 1½ tons a day, these were not only so much dead loss, but caused further trouble and inefficiency in the extraction processes. In this country, where the sugar content was generally high, the average yield was far too low on most farms, indeed, unless it could be raised from 8½ tons per acre to at least

10 or 12 tons, the industry would not survive the removal of the subsidy. Reckoning an average weight of only 16 oz. per root instead of the usual 20 oz., a full stand of eight plants per sq. yd. (say 9 ins. between plants in rows 18 ins. apart) would yield a crop of 17 tons. With care and good machinery 18 ins. was perfectly practicable. He advised farmers to get together and purchase proper beet cultivators, drills, lifters, and so on between them. It was in cultivation rather than in manuring that the average farmer went wrong: carrying out the operations carefully at the right time would give an increase of several tons, and proper manuring as well might add another ton or more. The seedbed should be fine and moist with the lower layers well broken to allow easy penetration of the roots, while thorough rolling before and after drilling was most essential. Plenty of seed should be sown for a good stand; 15 or 20 lbs. rather than 7. The adjustment of the drill, should be such that the seed was sown regularly and only just covered—certainly not more than an inch below the surface. Singling must be done carefully and methodically when the plants have 3-4 leaves (a week's delay here would mean several tons' loss), and to secure care the farmer might well pay by piece-work with a bonus on the ultimate yield. Hoeing by horse and hand—the number of hoeings depending on the soil, season, and cleanness of the field—should continue until the leaves meet in the rows.

Mr. H. J. Page, chief chemist of Rothamsted Experimental Station, said that in its demands on the supply of nitrogen, phosphates, and potash, although the quantities that must be supplied depended on whether dung was also being applied, beet was far in excess of the heaviest-manured of other crops. Reviewing Continental experience, the speaker said that while an adequate application of farmyard manure gave a good return, in the presence of artificials not more than 10 to 12 tons were advisable. The best source of nitrogen was nitrate of soda if applied as an early top-dressing (before June 20th); 2-4 cwt. per acre were used if dung was included, but 3-4 in its absence. Phosphates, best applied as superphosphate, were needed at about 2 cwt., or 3-4 in the absence of dung; neither the phosphates nor the nitrates of soda (if applied early) appeared to affect the sugar content. Potash was applied in the absence of dung at the rate of 3 cwt. of 40 per cent. salts, or 6 of Kainit: with dung no potash might be necessary, or at the most 4 cwt. of Kainit. The application of potash varied with the type of soil; on light soils, where Kainit applied in Autumn was best, the potash was important both as a manure and for the increase it effected in the sugar content; on heavy soils, the 40 per cent. salts, or muriate, were useful to raise the sugar content. In England experience varied considerably; while much more information was desirable, it seemed that phosphates were less generally necessary. In manurial experiments at Woburn the addition of a nitrogen dressing gave an increase of 10 cwt. an acre. A double nitrogen dressing increased the yield by one ton, but a treble dressing caused a fall of 19 cwt., giving an enormous increase in the amount of tops. Ordinary additional dressings of potash gave no increase in yield, but a 30 per cent. potash salts dressing added 17 cwt. an acre to the yield.

Mr. I. J. Schapringer remarked that sugar storage was greatest when there were warm days and cold nights in the later part of the season; frost was not a danger, since the roots would withstand up to 8° of frost when lifted and even more when in the ground; however, when once the beet had frozen it was advisable that they should remain so in storage until the time for slicing. In England, where the climate generally was more equable than

in Central Europe and the winters milder, the plant was growing continuously from sprouting of the seed to harvest, while the lifting period was so exceptionally long (up to 100 days) that on the same capital expenditure a factory could slice double the amount of beet.

Mr. R. N. Dowling, Notts County Agricultural Organizer, giving the results of a series of manurial experiments, stated that normally early top-dressing with nitrate increased yields; but that an excess of nitrate on a soil already in a high state of fertility from the application of farmyard manure might be actually harmful. In the same way, while a deficiency of potash limited the yield and should be treated, dressings on a soil which had already received potash during the rotation might be detrimental. In any case, while judicious manuring will promote the quality of a crop, bad climatic or soil conditions would upset all the influence of manures. Experiments conducted on the spacing of rows had shown little choice between 16·5 and 19 ins., but a perceptible increase (from 13 tons, 13 cwt., to 13 tons, 19 cwt.) at 23 ins.

Mr. J. L. Luddington said that in the King's Lynn district the cost of cultivation had been halved by growing sugar beet on ridges instead of on the flat, while the greater care that was possible had resulted in an increase of three tons in yield.

Mr. A. W. Ling summarized the results of 300 experiments conducted by Bristol University in the West Country, in the statement that while an appreciable alteration of the sugar content was not possible on an average, soil, yields per acre could be raised considerably, especially through better cultivation. Narrow sowing especially had given higher yields—rows at 15 ins., 22 tons; at 18 ins., 20 tons; and at 22 ins., 19 tons; it was found important also that singling should be done as early as possible. In manurial experiments, it was indicated that sugar beet could utilize the reserves in the soil better than most crops; with nitrogen, while good results were obtained with 1½ cwt. of sulphate of ammonia or cyanamide before sowing, followed by one top-dressing of nitrate of soda at singling time, excess of nitrogen brought no corresponding increase in root; rather a large leafy growth and late maturity. Potash was found to be beneficial on some light soils, but depressing on the Old Red Sandstone and on Lias clays.

Mr. F. Raynes, director of the Norfolk Agricultural Station, supporting the practice of growing beet on the ridge because of the ease and lower cost of cultivation, said that the slight fall in sugar content could be avoided by covering the roots with soil at the last hoeing. With regard to nitrogenous manures, his experience was that while there might be a falling-off in yield and a larger number of bolters if dressings were increased beyond a certain point, the time of application was more important than the quantity applied; the last top-dressing should not be later than singling.

Sir John Russell, thanking the speakers, said that it was evident from this Conference that in attempting to improve the yield of sugar beet it would be necessary to find the best varieties of beet, and the most suitable systems of cultivation and manuring for English conditions. Cultivation especially would require a large amount of experiment as to preparation of seed-bed, depth of sowing, width apart of rows, and ridge or flat cultivation, not losing sight of the whole economy of the farm or the variations in local conditions. Whereas with old crops whose cultivation had been established by tradition, manurial experiments were comparatively simple, here it would be impossible to be certain of improving manuring until the foundation of cultivation had been made sure. The problem of manuring was in this

connexion not simply one of stimulating a commercially valuable part of the plant to maximum growth; the growth of the whole plant and the translocation of materials within it must be studied.

IPSWICH CONFERENCE.

Mr. J. N. VAN BOMMEL VAN VLOTEN emphasized the necessity of growers paying attention as to the variety of seed they used. A great number of experiments was being conducted in Holland with a view of ascertaining the best seed for yield and sugar content; and, in stressing the necessity of this being done on an extensive scale in England, he pleaded for the most careful investigations being made in this connexion. Experiments had already shown that there were great differences in the quality of beet seed which farmers bought. Several Continental growers of beet selected their varieties under three heads. Two of these varieties were frequently indicated with the letters E to Z. The E seed provided heavy yields with low sugar content. and the Z seed provided less weight with high sugar content. The third variety, which came between these two, combined to some extent the properties of the other two. The question which of these types was to be preferred was a debatable one when such matters as soil and climate entered into the question. Farmers and manufacturers were often divided on this matter, and naturally, because it depended upon the price paid for the beet. There was no question that "bolters" not only depended on conditions of growth, but were also a definite property of the seed. Every year the same variety showed the largest number of "bolters," and purchasers of seed must be able to reduce the number of "bolters" to a minimum. Such a variety as soil should influence the variety of seed obtained, because there were no doubt certain soils which tended to give greater yield and lower sugar content. For such soils he, therefore, would not advise the E type of seed. English farmers were too strongly inclined to drill their seed at too long a distance apart. The rows should not be more than 16 ins. apart, and even 13 ins. might be sufficient, that being the width adopted in Holland. Beet sown in rows 18 ins., 20 and 22 ins. apart gave nothing like such good results, either in weight or in sugar content. as when sown in rows 14 and 16 ins. apart. The principal reason why he advised small distance between the rows was that sugar beet culture gave the best result with an even plant. Mr. VAN VLOTEN made a strong point against the liberal use of nitrogenous manures, particularly for late dressings, and strongly advisod growers not to allow their first deliveries to the factories to be beet grown from the Z variety of seed.

Mr. WILLIAM WILSON said that while drilling could be commenced about the middle of April, and could proceed until the end of May, it would be found that there were more "bolters" on the fields which were drilled early. Another disadvantage was that all the weeds had not germinated by the middle of April, but by the end of April or the beginning of May it could be safely assumed that all the weeds had been dealt with. His own experience was that the beet did well in Suffolk when the rows were apart, and, personally, he liked five rows in a 7 ft. 6 in. drill. He thought the depth of the drilling should be about an inch, and, as to the amount of seed, he did not think 15 lbs. to the acre was quite enough on ordinary gravelly soil; about 15 to 20 lbs. was necessary.

MAJOR NORMAN EVERETT introducing the questions of "lifting and delivering," said there was no hard and fast rule with regard to the former, for the process must depend on the nature of the land and the labour

Kirton Beet Seed Trials.

	Stock of Seed.	Sugar Content, Per cent.	"Bolters," Per acre.	Tared Weight of Beet, T.	c.	qrs.	lbs.	Value of Beet, Per ton.	Return Per Acre, *less* Carriage, £	s.	d.
1.	G. Schrieber & Son (Anglo-Scottish Beet Corporation)	14·5	1,580	5	2	3	24½	51/6	35	9	3½
2.	"Glostrup"—Hartmann, Copenhagen	14·3	1,800	2	12	3	13	51/0	27	12	7½
3.	"Janasz" (Anglo-Scottish Beet Corporation)	16·6	2,400	0	16	2	1	56/9	26	15	4
4.	Garton's Stock 3/25	16·8	1,660	2	6	2	13	57/3	30	16	1¼
5.	Garton's Stock 8/25	15·0	1,600	3	3	1	5	52/9	29	18	4¼
6.	Elsom's Stock No. 4	14·3	2,040	0	10	2	14	51/0	23	0	1
7.	Elsom's Stock No. 3	15·5	2,640	1	3	2	20	54/0	26	1	2½
8.	Elsom's Stock No. 2	15·2	2,190	1	4	1	27	53/3	25	15	8½
9.	Elsom's Stock No. 1	15·2	3,010	1	13	1	12	53/3	26	16	0
10.	Heine (Anglo-Scottish Beet Corporation)	16·1	2,890	9	18	2	6	55/6	23	18	6¾
11.	Hornung (Anglo-Scottish Beet Corporation)	15·1	1,660	2	4	2	17	53/0	27	19	2
12.	Buszczynski (Anglo-Scottish Beet Corporation)	15·9	6,180	8	6	1	20	55/0	19	15	9
13.	Klein Wanzleben (Anglo-Scottish Beet Corporation)	16·1	1,570	1	8	0	16	55/6	27	9	9¼
14.	Sharpe's Klein Wanzleben No. 4	15·1	2,630	0	15	2	10	53/0	24	12	8
15.	Sharpe's Klein Wanzleben No. 3	16·3	2,740	1	11	1	18	56/0	28	3	4½
16.	Sharpe's Klein Wanzleben No. 2	16·6	2,650	2	6	1	23	56/9	30	18	5½
17.	Sharpe's Klein Wanzleben No. 1	16·1	1,990	4	3	3	17	55/6	34	4	1
18.	Kuhn (Kuhn & Co., Holland)	17·1	550	3	19	2	6	58/0	35	8	8½
19.	Vilmorin, Paris—Stock B	16·6	3,490	11	10	1	21	56/9	29	4	3½
20.	Vilmorin, Paris—Stock A	17·4	2,200	12	17	0	6	58/9	33	1	3
21.	Marsters' Stock No. 4	18·0	210	14	17	1	6	60/3	39	7	5¼
22.	Marsters' Stock No. 3	17·6	70	14	5	2	6	59/3	37	1	7½
23.	Marsters' Stock No. 2	17·0	220	14	12	3	19	57/9	36	18	9½
24.	Marsters' Stock No. 1	17·6	4,240	11	10	3	1	59/3	30	19	4
25.	White Improved	17·6	2,730	11	19	2	9	59/3	31	2	2
26.	White French	17·6	2,420	12	12	2	25	59/3	34	3	1½
27.	Klein Wanzleben, England	17·1	2,340	12	8	0	4	58/0	31	8	9½
28.	Perfection, England	17·1	1,450	12	14	3	1	58/0	32	5	7½
29.	Mette (Anglo-Scottish Beet Corporation)	17·4	3,680	11	1	3	13	58/9	28	10	8½
30.	Mette—Heinr. Mette, Quedlinburg	18·3	2,170	13	18	3	18	61/0	37	8	11
31.	G. Schrieber & Son (Anglo-Scottish Beet Corporation)	17·4	2,030	12	2	2	19	58/9	31	4	11½
32.	G. Schrieber & Son—Schrieber	17·4	1,050	12	16	3	11	58/9	33	0	7½
33.	Webb's Selected White	16·3	2,060	13	3	0	19	56/0	32	0	9¼

available for the job. When it was done by hand the work was straightforward, but there were many suitable and inexpensive machines for the purpose. The important point was to get the minimum amount of dirt up with the beet.

These and other discussions were briefly reviewed by Mr. VAN VLOTEN. He added that there was uncertainty as to matters connected with the cultivation of sugar beet even in Holland, where the cultivation had gone on for 40 years, and it was hardly surprising that there should be uncertainty in England, where the industry was a comparatively new one. In general, he thought it might be said that nitrogenous manures decreased the sugar content, and that, on the other hand, superphosphate increased it. He recommended them to try to drill as early as possible, but wished to warn growers against accepting too hastily any conclusions relating to manuring and the time of drilling. These matters could only be determined by careful experiments.

Kirton Beet Seed Trials, 1926.

Several of the Continental beet seed firms have selected along special lines, and have put on the market stocks of seed suitable for various conditions, such as rich or poor soil, cool or warm climate, or wet or dry climate. Moreover, throughout the whole of the Continent the sugar beet season is earlier, if not longer, than in this country, the crop maturing in consequence at an early date. For the purpose of testing Continental stocks in this country, trials were instituted at Kirton in 1925 and again in 1926. A few stocks of English saved seed were also included. The results obtained are interesting from many points of view, particularly in showing the variation, not only in sugar content, but in the number of "bolters," and in the yield per acre between the various stocks.

Too much reliance, however, must not be placed on the figures, as it is now certain that much more elaborate technique is necessary to ensure reliable results. The plots, however, were $\frac{1}{10}$th of an acre in area, so that the probable error is somewhat reduced. It will be noticed that there is a more or less gradual increase in the sugar content from Stock No. 1 upwards. This is not due to a difference between the dates of analysis (though obviously it took some days to complete the series), as check analyses were taken from the first analysed plots after the others were completed. It would also be unreasonable to attribute the increase of sugar content to the stocks. The figures showing the number of bolters per acre may, however, be looked upon as being reasonably reliable, as the stocks were all sown within 24 hours, and the soil was in the same condition throughout the operation. Bolting may, of course, be caused by too early sowing, or by a check during the early stages of growth, but it is also an inherent factor in the stock. No doubt, by careful selection on the part of seed growers this defect can be largely eliminated. One or two firms on the Continent make a special point of eliminating bolters from their stocks, and this has shown up in the Trials.

The "Value of the Beet per Ton" is computed on a basis of 54s. per ton for 15·5 per cent. sugar content with 2s. 6d. extra for each additional percentage of sugar; in the final figures for the "Return per Acre" the sum of 6s. 7d. per ton on the gross yield has been deducted for carriage.

Refining Qualities of Raw Sugars.[1]

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Possibility of Financial Inducements.

If an attempt were made to modify the usual raw sugar sales contract now used, quite naturally the first demand from the producer would be for premiums on better raw sugars. Under the definition of better raws, this would mean raw sugars of higher test than the conventional 96° polarization. The usual raw sugar sales contract in present use makes certain allowance for tests above 96° and deductions for tests below 96°, and the calculations which follow demonstrate that the added allowances above 96° are entirely ample. On the basis of test, the refiner cannot afford to pay any additional premiums on sugars testing above 96° other than those now paid under the terms of the usual sugar contract. This may be seen by reference to Table II.

In regard to the yields to be expected from the refining of raw sugars of different tests, Coates[2] states "when sugars are refined on the toll basis the deliveries in granulated sugar per 100 lbs. raw were based on polarization, according to Table I. These figures represent perfect refinery practice and are the result of a number of years of practical work."

Using these yield figures, if the refiner pays 4·32 duty paid for his raws on 96° polarization, and obtains 5·60 for his granulated sugar, the margin from which he must pay his refining costs and other expenses, and make his profit, are shown in Table No. II. In these calculations the assumption is made that the products of refining operation are granulated sugar and its modifications, and refinery black-strap. The latter is valued at 9c. per gallon.

Table No. 1—Yield of Granulated per 100 Pounds of Raws.

Polarization Raw Sugar Degrees	Granulated Pounds	Polarization Raw Sugar Degrees	Granulated Pounds
98·0	95·0	94·5	90·4
97·5	94·5	94·0	89·5
97·0	94·0	93·5	88·2
96·5	93·5	93·0	87·7
96·0	*93·0	92·5	86·9
95·5	92·1	92·0	86·0
95·0	91·25		

* Standard

It is seen that the refiner's margin actually decreases slightly as the test increases. While there are some slight inaccuracies in calculating refinery yields according to this schedule, which affect the results slightly, in its broadest interpretation one cannot figure that the refiner is deriving any excess profit through the purchase of raws testing above 96·5° which should be returned to the raw sugar producer as premiums. On the other hand, one should not conclude that the refiner prefers 92° test raws because his margin is indicated as higher on the basis than on the 96° test basis.

These remarks are intended to illustrate the fallacy of grading raw sugars strictly on polarization, and to show that the existing schedule of premiums and penalties is ample on the basis of test alone. This basis of purchase, however, leaves much to be desired when attempting to arrive at the true value of the raw product to the refiner, as it does not differentiate between the superior refining qualities of certain raw sugars and the inferior

[1] Abridged from *The Planter*, 1926, 77, No. 13, 247-266. [2] *I.S.J.*, 1921, 228-229.

qualities of others. Although two different marks of raw sugars may each polarize 96°, and the ultimate refining yields may be quite similar, it is possible that one sugar may possess physical characteristics which render it costly and troublesome to refine.

TABLE No. II—REFINERS' MARGIN ON RAWS OF DIFFERENT TESTS.

Test of raws melted—	92	93	94	95
Cost of raws (approx.)	3·920	4·020	4·120	4·220
Granulated recovery, lbs.	86·000	87·700	89·500	91·250
Value of granulated	4·816	4·911	5·012	5·110
Gallons blackstrap produced (Basis of 79°Brix—40 Pur.)	1·350	1·160	0·940	0·740
Value of blackstrap	0·122	0·104	0·850	0·067
Total value of products	4·938	5·015	5·097	5·177
Margin for refiner	1·018	0·995	0·977	0·957
Test of raws melted—	96	97	98	99
Cost of raws (approx.)	4·320	4·420	4·480	4·540
Granulated recovery, lbs.	93·000	94·000	95·000	96·000
Value of granulated	5·208	5·264	5·320	5·376
Gallons blackstrap produced (Basis of 79 Brix.—40 Pur.)	0·540	0·540	0·540	0·540
Value of blackstrap	0·049	0·049	0·490	0·049
Total value of products	5·257	5·313	5·369	5·425
Margin for refiner	0·937	0·893	0·889	0·885

The refiner's margin is unusually small, and his refining costs and interest on money invested in refining plants leave him very little net profit per unit of refined product. As the latter is small and depends on the volume of business he is able to do, it is easily seen that if any adjustments are to be made for quality of raw sugars other than the usual price adjustments based on test, the matter resolves itself into additional penalties for sub-standards raw sugars.

CLASSIFICATION OF RAWS.

The quality of the raw sugars offered by the manufacturer reflects to a considerable extent the manufacturing conditions existing in his factory. There is, of course, the influence of the soil and climatic conditions on cane quality, and where much burnt cane is encountered the quality of the raw sugar produced suffers because of the inability of the manufacturer to cope with the clarification problems which arise. Raw sugars produced in factories having high melassigenic factors should, according to the usual theory, contain larger percentages of ash. The relation between the ash in the mill juices and the ash content of the raw sugars produced therefrom is generally over-estimated, and the author will attempt to show the influence of other factors of more importance which are generally not given the consideration they deserve. One refiner has a system of raw sugar grading which has been in operation nearly three years. While no use of the system is made in the purchase of racs, it enables those in charge of refinery operation to accumulate information which is of value in tracing certain discrepancies between test and refinery yield which could not be explained on the usual basis of recovery per 100 lbs. of 96° test raws. While details of the system will not be given here, it places raw sugars from different centrals into four general classes, i.e.: "A" those of exceptional refining qualities; "B" of average quality and refining value, a broad classification; "C" of subnormal value; "D" of extremely undesirable qualities. Table III represents data on the totals and percentages by mark of Classes A, B, C and D sugars received from five Cuban provinces during the year 1925.

TABLE III—CLASSIFICATION OF OUTPUT OF DIFFERENT CENTRALS.

(No. and percentage of centrals under each classification)

Province—	—A— No.	Pr. Ct.	—B— No.	P Ct.	—C— No.	P.Ct.	—D— No.	P.Ct.	Total Marks	Total P. Ct. A&B	C&D
Habana	—	—	6	75·0	1	12·5	2	12·5	8	75·0	25·0
Matanzas	1	5·3	11	57·9	7	36·8	—	—	19	63·2	36·8
Santa Clara	6	18·2	12	36·4	11	33·4	4	12·0	33	54·6	45·4
Camaguey	—	—	1	50·0	—	—	1	50·0	2	50·0	50·0
Oriente............	—	—	5	41·7	2	16·6	5	41·7	12	41·7	58·3
Totals and averages	7	9·5	35	47·3	21	28·4	11	14·8	74	56·8	43·2

A study of this table seemingly indicates that raw sugar quality is directly influenced by the geographic location where it is produced. Havana province shows the greatest percentage of centrals in Classes A and B, and the percentages under this heading steadily decline for the provinces located towards the western end of the island. However, there are hardly enough data available on Camaguey, Havana and possibly Oriente to warrant any definite conclusions. Furthermore, the influence of geographic location can hardly explain why Santa Clara province should have 18·2 per cent. of her total in Class A and 12·0 per cent. in Class D; whereas Matanzas, which is just above Santa Clara in the table and just east of it geographically, has only 5·3 per cent. of her total in Class A and none in Class D. There are many other such examples of the inconsistencies of soil type *vs.* raw sugar quality which could likewise be pointed out. Undoubtedly, there are other influences involved which are of equal or greater importance in their relation to raw sugar quality.

CLARIFICATION AND H.I.C.

This one operation in the fabrication of raw sugars may thus influence the ultimate profits of both the raw sugar producer and the refiner who buys the former's product. Cane juice clarification processes are apparently very simple, but the reactions involved are very complex. However, recent advances in the application of hydrogen-ion control to clarification have made the handling of the process much easier. Bearing in mind one fundamental principle, i.e., that the clarified juice must be delivered to the pans as a syrup testing *pH* 7·0 or somewhat more alkaline if necessary, the raw juice should be limed to the point where very simple experiments indicate that the most brilliant and quick-settling juice has been obtained. The author has seen indications that most cane juices have two zones of maximum coagulation of their impurities, one somewhat below *pH* 7·0, especially when some sulphur dioxide is used, and the other zone is located on the alkaline side of neutrality. It is the latter point which must necessarily be worked for, and where lime is used without other chemical defecants the liming is carried to a point where the efficient juice from the clarifiers is of *pH* 7·4 to 8·0, the exact reaction depending on the appearance of the juice. The optimum point will vary with the cane, but can be easily identified and re-located when necessary. The object is to always have a brilliant juice which is as free from turbidity as possible, yet not carry the alkalinity high enough to impart a deep red colour to the clarified juice. The point where the finely dispersed colloidal "haze" has disappeared, and the juice takes on a "polish" or brilliancy quite characteristic of this optimum point, is what should be worked for in clarification practice. Under the old system of titrations with standard alkalis and acids, it seemed impossible to connect this point with any titration value, and if titrations and hydrogen-ion deter-

minations are made side by side on the same samples it will be found that the titrated values will vary while the hydrogen-ion value is practically constant.

SUGAR BOILING.

Good clarification, therefore, yields definite returns to the raw sugar manufacturer, provided the good work of the previous station is not ruined by the sugar boiling. Good boiling can cover a multitude of clarification faults by working the sugar into clear, uniform crystals which the refiner can handle satisfactorily. On the other hand, the clarification may be of the best, but poor sugar boiling can produce a sugar from it which is very unsuitable for refining purposes. In the author's opinion, the crystal characteristics of raw sugars are the most important physical features attached to their refining value. This factor also bears a direct relationship to the chemical composition of the raw sugars produced from any type of clarifier juice.

LUNDEN[1] estimates that when boiling lower grades of beet juices, apparent purity of 85 or lower, the purifying effect of crystallization on mineral impurities produces a sugar containing only 1-50 of the impurities of the original massecuite. For organic impurities this may be only 1-25. Assuming a purifying ratio of only 1-5 for raw cane sugar of 96 test, and that two cane juices, one of which contains twice the ash present in the other, were boiled into 96 test raws of identical crystal characteristics ; would it naturally follow that one sugar should contain twice the ash of the other ? Do not the efficiency of the clarification process, the crystal characteristics of the sugar produced in the vacuum pans, and the relative purging efficiencies (as influenced by crystal types in the massecuite) in the centrifugals, influence the composition of the non-sugars appearing in the commercial sugar ? Anyway soil and climatic conditions are not the dominant factors in determining raw sugar quality.

Elimination of turbidity and of colloids is a clarification problem, and the reduction of excessive amounts of surface films is brought about by boiling sugar of clear, uniform crystal characteristics which will purge satisfactorily in the centrifugal machines. As will be subsequently shown, there are other important arguments for good sugar boiling in its relation to the production of commercial raw sugars which will not undergo excessive deterioration. Losses from this cause directly affect the raw sugar producer and should receive more attention. While it is realized that canes which are hard to work are encountered in some localities, and that in any locality canes of this type will frequently be encountered, unquestionably the influence of this factor on the quality of raw sugars has been greatly over-estimated, and there is a general tendency to under-estimate the profitable returns to both raw sugar manufacturer and refiner from closer attention to little details of clarification and boiling house practice in the raw sugar central.

HOW THE REFINER JUDGES QUALITY.

Two sugars having the same polarization do not necessarily yield the same in the refinery, and although the percentage difference is small the difference may run into large figures during a year's operation. As the refiner is dealing in large volumes and small profits per unit of product, complaints are often registered against high percentages of ash and other impurities of melassigenic nature. Certain physical characteristics of raw

[1] *I.S.J.*, 1926, 560.

sugars often harass the refiner more than the usual chemical factors affecting yields. These characteristics, which may cause large increases in operating costs, are not necessarily controlled by the polarization, and, therefore, are not taken into consideration in arriving at the cost of raws. Under the the classification of physical characteristics the author places colloidal non-settling matter and gums, crystal characteristics, and colour. Of course, some of these also possess chemical identity but the percentages by weight are small and appear as insignificant when listed in an ordinary chemical analysis. Yet they are very important in their effect on refining costs and operating efficiency.

Non-settling matter and gums.—These effect the filtrability of the washed sugar liquors and affination syrups, causing increased consumption of chemical defecants or filter medium and may also seriously interfere with granulated and soft sugar production because of the inability of the wash plant to furnish enough liquor and syrup when the refinery is running at maximum capacity. The refiner tests raws for filtrability by certain tests which will not be described here. Proper clarification practice tending to produce a minimum of colloidal non-settling matter in the pan syrups, and boiling house practice requiring the least quantity of massecuite per unit of solids are means of improving filtrability of raw sugars. Rapid concentration and a boiling system which tends to reduce the amount of non-settling matter in the massecuites from which the larger proportion of commercial sugar is boiled will yield a raw sugar of better filtering qualities.

Crystal characteristics.—If the surface area contained in a given volume or weight of raw sugar having uniform crystals averaging 0·8 mm. diam is compared with a similar column or weight of sugar having fine, mushy, crystals ranging between 0·2 to 0·4 mm. in diam., the difference in surface area will be surprising. Increased surface area means an increased amount of molasses film bearing the impurities which decrease the filtrability, and increase the ash and colouring matter. Moreover, crystals of the latter type do not purge as cleanly and very often if very fine crystals are present the manufacturer is forced to resort to excessive washing to get the molasses out of the sugars. This practice decreases the density of the molasses film next to the crystal and promotes some solution of the crystal into the film. Since the latter offers an ideal media for certain sugar destroying bacteria, yeasts and fungi, deterioration of the polarization is likely to follow with consequent loss to the manufacturer. If raw sugars were made with crystals which allow satisfactory purging, the central could consistently produce commercial sugars which will conform to a deterioration factor of 0·25 or less at the factory, and the refiner would be assured of receiving raws which will affine satisfactorily. The magnitude of these deterioration losses is seldom realized, and the possible savings to be effected through reduction of such losses through better sugar boiling deserve more consideration.

Colour.—Colouring matter in raw sugars, from the refiner's standpoint, is usually of secondary importance to crystal formation. However, there are notable instances where the colouring matter in raw sugars can give the refiner considerable trouble, especially where much colouring matter is within the crystal and in cases where high colour is associated with bad crystal characteristics. Spectrophotometric methods of colour determination are rapidly gaining favour in refinery work, and are especially valuable in grading raw sugars. The " quality " of the colouring as well as the amount present is indicative of the conditions under which the sugar was manufactured.

Refining Qualities of Raw Sugars.

The author,[1] in a recent paper, has furnished spectrophotometric analyses of the common types of raw sugars, and discussed the connexion between the absorption trends shown by these sugars, and the factory conditions under which they were produced. These data interpreted in practical terms, imply that sugars are greenish, grey, bright or deep red or brown, according to the method of manufacture employed, and that each type of colouring matter present shows a different degree of resistance to refinery decolorization processes. In any case, however, the most preferred type of colouring matter in raw sugars is that with a high absorption for light in those parts of the spectrum located between the wave lengths of 440 and 540 mu, and low absorption in the opposite end of the spectrum, provided the total colour does not exceed certain limits. Although crystal characteristics render it difficult to attempt a description of absorption trends of this type in terms of what we visualize when examining the raw sugar, itself, it may be safely said that the bright golden or yellowish brown raw sugar which the practical man recognizes so readily as a good raw is the type which answers the spectrophotometric description given above.

Characteristics of a Good Raw Sugar.

The following is a description of a typical good raw sugar. While these specifications are somewhat rigid and higher than the quality of the average good Cuban raw sugar, it is a standard which the average Cuban central can easily attain. During the season of 1925, one refinery received raw sugars from 74 Cuban centrals, 7 of which easily and consistently furnished raws conforming to this standard or bettering it.

Crystals shall be uniform, hard and sharp; average diam. of not less than 0·6 mm., or over 1·0, preference being given to 0·8 mm. crystals. There shall be few fine or needle-shaped crystals which tend to form dense layers next to the centrifugal basket linings in the washing operation, as well as increase the affination losses. When viewed by projection of their images on a screen (see Meade[2]), the crystals should be regular and of good shape. The colour value by spectrophotometric analysis at wavelength of 560 mu, expressed as minus log. specific transmissivity, shall not exceed 0·7500. The spectral absorption trend shall conform to the usual standard absorption ratios for a bright sugar. With a total colour value of less than 0·7500, the higher the absorption trend at 440 mu, the more suitable the sugar is for refining purposes, since this indicates that the colouring matter present is due to caramelization of an incipient nature and the absence of greyish colouring matter indicating improper clarification of ferric iron-polyphenol compounds. A typical caramel trend in a sugar of this type and low total colour content indicates that the sugar was boiled from juices undergoing very complete clarification with subsequent elimination of a maximum of impurities, yet the clarification was not heavy enough to cause the formation of too much red colouring matter.

Polarization: 96·0° or more, at 20° C.; ash, at maximum temperature of 750° F. not exceeding 0·45 per cent.; moisture, as determined by drying *in vacuo* at 80° C. to constant weight, shall allow the sugar to conform to a safety factor of 0·25. Filtrability: crystal formation indicates how the boiling process was carried out, and if it conforms to the specifications mentioned above, such factors as moisture content, ash percentage, and filtrability, are usually cared for satisfactorily through the reduction of surface films which carry these impurities. If the sugar conforms to the colour

[1] *I.S.J.*, 1926, 482, 547. [2] *I.S.J.*, 1922, 158.

specifications mentioned above, this will indicate that the sugar was boiled from the most efficient clarification. Therefore, if the clarification was correct, the juice will contain a minimum of non-settling matter, gums, etc., which affect the filtrability. Consequently, in attempting to grade raw sugars, it appears more logical to have the specifications cover qualities of the raw sugar which are directly influenced by the manufacturing processes of clarification and boiling. In attempting to improve filtrability, the manufacturer must get better results from these processes in order to accomplish the desired improvements, so the grading specifications may as well be based on the characteristics directly determined by these processes, i.e., grain and colour characteristics.

Evaporating and Heating Systems in Cane Factories.

By GEORGE W. CONNON.

The great majority of cane sugar factories to-day use straight quadruple effect evaporation and heat the raw juice with exhaust steam, a system which until quite recently has been considered standard practice. But for a number of years beet sugar factories have been using a more efficient evaporating system than this. They have no combustible by-product like bagasse, and the expenditure for fuel is one of their largest cost items. The cane sugar industry has been slow to take advantage of these improvements, but especially with the growth of electrification, more efficient methods are coming into use, with decided reduction in the amount of fuel required and increase in the amount of maceration water that can be used.

SYSTEMS USING VAPOUR ("EXTRA STEAM.")

The first step in increasing efficiency beyond the straight quadruple effect system is the use of vapour (so-called "extra steam") for heating the raw juice; which method reduces the total fuel required to operate the factory about 4½ per cent. There are now quite a number of factories in Cuba using this system. Since the first cell has to supply vapour to the heaters as well as to the second cell, it must have considerably more heating surface than the other cells. An alternative arrangement of this system is composed of five cells, of which four form a straight quadruple and the fifth has exhaust steam supplied to it, furnishing vapour to the heaters only. In improving old factories the first of these arrangements can be used when the existing evaporator is a triple effect, the second when it is a quadruple effect. With either of these arrangements the total heating surface in the evaporating plant need be no greater than that of a straight quadruple to evaporate the same amount of juice. The heaters, however, must be somewhat larger, for the vapour with which they are supplied is of lower temperature than the customary exhaust steam.

Quintuple effect evaporators have been installed in a few factories, some "straight" and some with vapour-heating. With dilute juice equal to 110 per cent. on the cane, the straight quintuple system reduces the total steam consumption of the factory by about 5½ per cent., i.e., it gives 1 per cent. better economy than the system just described. However, the total heating surface required for any quintuple system is about 28 per cent. more than for the quadruple systems (assuming the same exhaust pressure) so that at the present scale of prices the use of a straight quintuple as against a quadruple

[1] Reports of the Association of Hawaiian Sugar Technologists, 1926.

with vapour heating is not justified. There is one sextuple effect installed in Cuba ; vapour is taken from its second cell for the heaters.

A further application of the vapour-heating principle is the use of what might be called a " dead-end " double effect, this consisting of two cells of which the first is operated with exhaust steam, and the second sends all its vapour to the juice heaters. There are no connexions on the steam or vapour side between this evaporator and the quadruple effect, but the partly concentrated juice from the dead-end evaporator is sent to the multiple effect to be made into syrup. This system enables the factory to be operated with 8½ per cent. less steam than would be required by a factory using a straight quadruple, and the total evaporator heating surface is no greater. A " dead-end " triple effect is in process of manufacture for one of the Cuban factories, all three cells of which will furnish vapours to juice heaters on the counter-current principle. The cold juice will pass first through the heater supplied with vapour from the third cell, then through that supplied from the second cell, and the final heating will be performed by the heater supplied from the first or hot cell of the triple effect. In this same factory there will be installed a separate cell which will supply to the vacuum pans vapour for 75 per cent. of their work. This cell, as well as the " dead-end " triple, and the small quadruple effect in which the final concentration to syrup will be performed, will be operated on exhaust steam. It is expected that there will be carried a rather high exhaust pressure in order that the pressure of the vapour for the pans may not be too low. The success of any of these systems of utilization of vapour requires that the apparatus using the vapours be especially designed with this end in view. It has happened more than once that a vapour-heating system has been condemned on account of the unsuitable design of the heaters used. A definite path for the vapour, covering every part of the steam space, and a proper design of the air-venting, are the most important points.

Systems using a Pre-Evaporator or " Pauly."

The schemes described above are all operated entirely with exhaust steam. But in factories whose production of exhaust steam is small (usually when electrified) it is possible to use an evaporator cell to produce exhaust steam. Such a cell is in Cuba called a pre-evaporator or " Pauly " (we never use the term " pre-evaporator " for a cell that receives exhaust steam in its calandria). Live steam is admitted to the calandria of the pre-evaporator, usually at the maximum of 40 lbs. pressure, and its evaporation is discharged into the exhaust steam main. The quantity of live steam admitted to the calandria is regulated (sometimes by an automatic-control apparatus) so as to cause just sufficient evaporation to maintain a constant pressure in the exhaust main. The capacity of a pre-evaporator, and consequently its benefit to the steam economy of the factory, depend on the shortage of exhaust steam in the remainder of the factory. Roughly, each pound of exhaust steam that the pre-evaporator can send to the mains means a pound less evaporation for the quadruple effect to do, and a consequent reduction of one-quarter pound in the total steam required to operate the factory. Accurate calculation shows that the advantage is actually a few per cent. less than this, but it is still very great; due to the great difference of temperature between the calandria and the boiling juice, a tremendous rate of evaporation can be obtained. The pre-evaporator is therefore the cheapest way to increase the capacity and economy of a factory. They are now in operation in a number of the larger and more efficient factories of Cuba. It is of course essential to study the

steam balance of each individual factory, to discover whether the shortage of exhaust steam is sufficient to permit of the use of a pre-evaporator.

The latest development in pre-evaporator systems is the " regenerative " pre-evaporator. This is a large pre-evaporator fitted with a battery of "thermo-compressors," which are a sort of steam injector. The cell boils at exhaust pressure and sends part of its vapour to the exhaust steam main of the factory, the remaining part going to the thermo-compressors where it is compressed by means of live steam, and forced, together with the live steam used to perform the compression, into the calandria. Thus there is performed two to two-and-a-half pounds of evaporation for every pound of live steam used, so that the economy is better than a double-effect pre-evaporator would be. The thermo-compressors are usually controlled by an adjustable automatic regulator, so as to maintain the exhaust pressure at whatever figure may be desired. One of these regenerative pre-evaporators was installed at Central Vertientes three years ago and has been in successful operation ever since. For the crop of 1925-26, when a second tandem was added and the factory doubled in size, a duplicate regenerative pre-evaporator was ordered. Vertientes also has two " dead-end " double effects furnishing vapour to juice-heaters, and two quadruple effects. The week preceding Christmas (the second week of the crop) was started with the bagasse storage house empty. During that week the fibre in cane averaged only 10·07 per cent., and the maceration 16·14 per cent., nevertheless enough surplus bagasse was accumulated so that all the vacuum pans were operated for a period of six hours after the mill stopped grinding, and all the centrifugals eighteen hours, and still there was a comfortable surplus of bagasse remaining to start the fires for the following week.

COMPARISON OF SYSTEMS OF EVAPORATION.

The following table will give a clear comparison of the relative economies of the various systems, and the relative total heating surfaces of the required evaporating plants. Let it be also understood that every increase of economy carries with it a decrease in the size of the condensing system as well as a decrease in the boiler-plant; that is, the condensers, the injection water pumps, the cooling-pond (if any) and the vacuum pumps, can all be reduced. The net result is that a factory using one of the more economical evaporating systems can usually be installed for a less cost than a standard factory using the straight quadruple-effect system.

	Cuban Conditions.		Hawaiian Conditions	
	Boiler H P	Evaportors Sq ft.	Boiler H. P.	Evaporators Sq. ft.
Quadruple	3,230	17,000	3,540	22,700
Quadruple with 1st cell vapour to Heaters	3,080	17,000	3,360	22,700
Quadruple with dead-end double to heaters	2,980	17,000	3,250	22,700
Quadruple with dead-end triple, heating from all three cells	2,820	19,100	3,060	25,100
Ditto plus single cell to furnish vapour for 75 per cent. of pan-work	2,560	19,100	2,850	25,100
Quintuple	3,020	21,890	3,290	29,000
Quintuple with 1st cell vapour to heaters	2,920	21,800	3,140	29,000
Quintuple with 2nd cell vapour to heaters	2,810	21,800	3,010	29,000
Sextuple with 2nd cell vapour to heaters	2,710	26,700	2,880	35,600
Quadruple with dead-end double to heaters and regenerative pre-evaporator	2,640	17,000	2,930	22.700
Quadruple with 1st cell vapour to heaters and for 75 per cent. of the pan-work, and regenerative pre-evaporator	2,570	17,000	2,880	22,700

The values in this table are for a factory grinding 2400 short tons of cane per day (100 tons per hour). The first set of figures represent good average Cuban conditions, viz., dilute juice 95 per cent. on cane and 16·3° Brix, and syrup of 57° Brix, though it must be noted that the modern factories are designed to handle dilute juice up to 105 per cent. The second set of figures is supposed to represent average Hawaiian conditions, viz., dilute juice 115 per cent. on cane and 13·3° Brix, and syrup of 63·3° Brix. The heating surface for the evaporators is figured for an evaporating rate of 8 lbs. per sq. ft. for a quadruple, which has been obtained as a safe working rate by the "Two-Flow" calandria. In the "dead-end" triples, the three cells are worked at the same evaporating-rate as a quintuple.

To show the possibilities of modern practice in reducing the cost of a factory (and hence the fixed charges to be borne by every lb. of sugar), consider the most efficient of the "Quadruple" systems listed above and assume that the boiler-plant is operated at 150 per cent. of rating. The actual h.p. of boilers to be installed will then be 1710 h.p. plus a spare unit, or say a total of 2280 h.p., instead of 5000 h.p. total as has usually been recommended for a standard factory in Hawaii. However, it is not always possible to use these high-economy systems. Firstly, there is no economy in reducing the consumption of exhaust below the amount produced so that the exhaust which is saved is merely blown out through the roof. This may happen in non-electric factories, especially small ones; in these a quadruple with vapour-heating from the first cell is about the most efficient system that is feasible. But in large electric-driven factories, with superheat and moderately high steam-pressure, the most efficient systems can be used. Secondly, it is useless to reduce the steam requirements to such a point that the factory has a constant surplus of bagasse that will have to be carted away. This may occur if the amount of maceration water used is small, or if the cane has a high fibre content, in factories that have no outside load such as irrigation pumps, or electric railroads for hauling cane, or lighting of nearby towns. Another point to be considered is the amount of maceration water that is, or can be, used. In Cuba one cannot use as great a percentage of maceration as in Hawaii, for the amount of cane ground per sq. ft. of roll is so large that the mills choke if heavy maceration is attempted.

In Hawaii, with a boiler-plant reasonably well-designed and carefully operated, and if no outside power is required, quadruple-effect evaporation should be found just about sufficient to eliminate the necessity of burning extra fuel, which makes the problem fairly simple. But in Cuba, where the fibre in cane averages 10·5 per cent. and at some factories less than 10 per cent., it becomes necessary to use the more efficient systems. Where outside power can be utilized, such as for supplying nearby towns with power and light or to operate irrigation plants, then the most efficient boiler plant and evaporation systems should be used, so as to obtain the maximum possible power from the bagasse. In such cases the entire problem should be studied together, so as to discover the most economical combination. Some of the Hawaiian factories, having a large market for power in their irrigation plants, offer very interesting problems in that respect.

Prof. Dr. E. O. von Lippmann, the distinguished writer of many historical and other works, recently celebrated his 70th birthday. He has been the recipient of many expressions of goodwill from chemists of all nationalities. It is hoped that he will have the health and strength to pursue yet for a good few years to come his literary studies which have had valuable results to our industry.

Publications Received.

Technische Organisation im Zuckerfabriksbetriebe. Dr. Hermann Gutherz. Tagesfragen aus der Zuckerindustrie, No. 4; edited by Dr. Oskar Wohryzek. (Albert Rathke, Magdeburg.) 1926. Price: 2 marks.

Dr. Gutherz, manager of the Selyp beet sugar factory, Hungary, outlines his schemes for supervizing operations so as to work under the most efficient conditions and with most economy during and after the campaign, describing to this end what is done in his own factory, though he does so, he points out, not as an example, but rather by way of suggestion. He discusses in detail the keeping of books and of control and cost sheets for the estimation of the routine and depreciation figures, attributing considerable importance to the compilation of statistical tables in which the consumption and cost of materials are compared with the figures for preceding years. He advocates a free exchange of all data with other factories through a central organization. In a chapter dealing with the work of the chemical laboratory, he is insistent on the permanent engagement of the chemist, even for small concerns, work of another kind being found for him during the inter-campaign. This booklet contains many useful suggestions, and its perusal may be recommended.

Encyclopaedia of Beet Sugar Manufacture. By Prof. M. D. Sujew. (Published at Kiev, Russia.) 1926.

This is a comprehensive and important work in Russian in seven volumes, dealing in the first four with the several stages of manufacture, in the fifth with chemical control, and in the sixth and seventh with boilers and machine technics. Each volume contains 400-500 pages, and a further volume is in preparation dealing with construction. It is proposed to translate this work into German.

Elektrizität in der Zuckerindustrie. (Published by the Allgemeinen Elektrizitats-Gesellschaft, of Berlin.) 1926.

This is a special catalogue published by the A.E.G. of Berlin dealing with the introduction of electricity into the German sugar industry, and the present position of this branch of technology. Particulars are given especially of the Stuttgart "electrified" factory.

Alcohol for Industrial Purposes. (American Solvents and Chemical Corporation, New York City.) 1926.

This pamphlet contains formulae and specifications in respect of the use of industrial alcohol, indicating in a general way the regulations covering its use and describing in detail the composition of the formulae for completely denatured alcohol, as well as the composition and authorized use of the formulae of specially denatured spirit. In the U.S.A. the consumption of denatured alcohol in the various industries of that country now amounts to the total of 81,000,000 gallons, and is rapidly increasing.

Volume Alterations on and in Solution. F. L. Teed. (H. K. Lewis and Co., Ltd., London.) 1926. Price: 3s. 6d.

A monograph divided into three sections: (1) A method for ascertaining the volumes of the constituents of a mixture, after mixture; (2) a method for ascertaining the rate of expansion by heat of the constituents of a mixture, after mixture; and (3) a suggested working hypothesis to explain certain abnormal specific heats of alcohol mixtures.

The Eastern Alcohol Corporation, owned jointly by the Du Pont Company and the Kentucky Alcohol Corporation, subsidiary of the National Distillers, has begun the manufacture of industrial alcohol at its new plant at Deepwater Point, N.J., U.S.A. The plant has a capacity of ten million gallons of alcohol and will supply the needs of the Du Pont Company and its affiliated companies, which, as a whole, are the largest users of industrial alcohol in the world.

Trade Notices.

From Messrs. BLAIR, CAMPBELL & MCLEAN, LTD., Govan, Glasgow, come two illustrated bulletins, one on Modern Multiple Effect Evaporators, and the other on Mill Roller Grooving. The former deals with a speciality of this firm, the Side Separator Multiflex Evaporator. The special feature of this evaporator is that the mixed liquor and vapour, on rising from the evaporating tubes, passes tangentially into a "Side Separator," where the vortex motion thus produced greatly facilitates the liberation of the vapour from the liquor, and materially assists in reducing entrainment to a minimum. A portion of the liquor passing to the side separator is returned to the bottom of the evaporating vessel for further circulation, and the partially concentrated balance is passed forward as feed to the succeeding evaporating vessel, the various connecting pipes all being provided with regulating cocks or valves—which require practically no attention after having once been adjusted to suit the rate of working—and special sight glasses through which the liquor flow can readily be observed. The circulation in the "Multiplex" evaporator is claimed to be very rapid, so that the evaporative rate is unusually high, and the liquor passes through in the shortest possible time. This is of special importance with sugar and other liquors where prolonged exposure to boiling temperatures may cause inversion or other similar changes, or discoloration of the product. The leaflet on Grooving depicts a number of styles that have been adopted by this firm as their standard and should be found generally satisfactory. Both the above lists can be obtained on application to the firm in question, the first being Catalogue 113, and the other, Leaflet No. 114.

The CELITE PRODUCTS CORPORATION (147, Windsor House, Victoria Street, London, S.W. 1.) have issued a booklet entitled "The Logic of Insulation" which is a description of heat insulation and the application of suitable insulating material to reduce heat losses through walls. They specialize in a form of cellular brick which they have named Sil-O-Cel, which contains as much as 85 per cent. of minute air cells, and is made from natural mineral celite. This brick is claimed to be on the average about ten times as effective in retarding the passage of heat as are refractory materials. The usual application is to instal a 4½ in. course of Silocel insulating brick between 9 ins. of firebrick on the inside and a double course of red or common brick on the outside. Further details as to the various types of Silocel bricks made and their range of application can be had on application to the Celite Products Corporation.

Canada, according to reports from official sources, produces yearly about 10,000 short tons of maple sugar, of which 70 per cent. comes from Quebec, 25 per cent. from Ontario, and the remainder from the Maritime Provinces. By-products are fine vinegar, malic acid and the baking powder substituent, bimalate of lime. The markets for Canadian maple products could easily be greatly extended. The British market alone could absorb the entire Canadian production with ease.

At the Fourth Annual Convention of the Philippine Sugar Association, Mr. E. C. ZITKOWSKI was reported as having made the following recommendation : "That the use of litmus paper, and the terms 'acidity' and 'alkalinity,' as determined by titration, be discontinued as a guide in liming raw juice in our factories, and that we use the Hydrogen Ion Concentration as a basis for alkalinity control, reporting it in terms of H. I. C., instead of 'alkalinity' or 'acidity,' which are extremely misleading."

"The application of electric drive to the mills offers many advantages over the older method of steam drive, but this is still a much discussed question.[1] It is our opinion based on actual study in a factory having a steam driven unit and an electric driven unit, that the economies obtained by electrification more than offset the slight advantages of closer speed regulations, possible in the steam unit. A new feature in favour of electric drive is the development of the variable frequency governor on the turbines, which gives the desired speed regulation."

[1] WALLACE MONTGOMERY in *Sugar*, 1927, 29, No. 1,

Brevities.

A number of installations of the Oliver filter have recently been made in raw sugar factories of Hawaii. As the capacity of this filter is 6-8 times that of a plate-and-frame apparatus of the same filtering area, this means a large saving in the initial cost of equipment, as well as economy in cost of cloth and labour.

Dr. HARALD LUNDEN points out[1] that caramel colouring substances behave very much in the same way as the indicator dyes used for the determination of the *pH* value, the alterations in their intensity on the addition of acids, for example, following the same general lines as demonstrated by MICHAELIS for certain indicators.

Messrs. THOMAS BROADBENT & SONS, LTD., Centrifugal makers, of Huddersfield, have now opened their own office at Glasgow under the management of Mr. EDEN FIELD, who has been with them for many years. The address is 65, Bath Street, Glasgow.

A glucoside, found in kaáheé (*Stevia rebaudiana*) a plant grown in the desert regions of Eastern Paraguay, is stated to have a sweetening power nearly 200 times that of sugar, though, like saccharin, it has no food value. It has yet to be established however that the glucoside is wholesome. Experiments are to be carried out with the plants by various investigators who have obtained seed for the cultivation of the plant from the Department of Agriculture, Washington.

Rotary kilns are being advocated for the burning of limestone for the production of caustic (temper) lime for use in sugar factories and other purposes ; some of the advantages claimed are that : the fuel consumption and labour cost are both lower than for vertical kilns ; the temperature of the burning zone can be very carefully controlled, rendering it possible to burn rather impure grades of limestones ; and materials as calcite, and coral-rock, can be treated satisfactorily.

The Trade Facilities Act is considered to have served its purpose by now and the Government are no longer offering loans to business firms under its provisions. Amongst some of the last applications that were made in the Autumn were the Anglo-Scottish Beet Sugar Corporation Ltd., which obtained an additional guarantee of £240,000, and the Orchard Sugar Co., Ltd., of Greenock, which was allowed an additional £100,000.

At the National Physical Laboratory, Teddington, as the result of a long investigation, it has been shown that in the case of spirit thermometers a certain error occurs after a time. It had been noticed that such thermometers showed a marked fall in their readings when exposed to the same temperature after a lapse of some years, and this was proved to be due to the presence of compounds as acetone in the methylated spirit employed, this impurity condensing to a liquid product under the influence of light in course of time.

The FARREL FOUNDRY & MACHINE CO., of Ansonia, Connecticut, have completed arrangements for Mr. J. W. STEENBLIK, of the Royal Bank of Canada Building, Havana, Cuba, to act for them in a consulting capacity. This gentleman has been actively connected with the manufacture of raw and white sugars in all their phases for over 25 years, in Java, Porto Rico, and Cuba. He was formerly connected with GEBR. STORK & Co., of Hengelo, Holland, and for a time acted for them as their Cuban representative. Latterly, he has been engaged in consulting business on his own account and has been consulting engineer for a number of the large mills in Cuba. His activities cover the designing, erecting and operating of sugar houses.

Discussing the question of "Standardization in Chemical Analysis" before the Manchester Section of the Society of Chemical Industry recently, Prof. W. H. ROBERTS said that he did not believe in standardization as a fixed general principle, but only in cases where a particular process was dealing with something indefinite. He remarked that it is not so much in the process itself that differences occur but rather in the sampling and in the preparation of the sample. It is the duty of every analyst to work out his own process, and to test everything for himself, not relying implicitly upon everybody's statement in a textbook. There are far too many traps for the unwary in standard methods of analysis. A process that had been standardized is the determination of the strength of alcoholic liquid, by means of the Sikes hydrometer, yet incidentally there are very few such hydrometers outside the laboratories of responsible chemists that are accurate.

[1] Centr. Zuckerind., 33, No. 327, 117.

Review of Current Technical Literature.[1]

Report on Manufacturing Machinery. **Irwin McNiece.** *Proceedings of the Fourth Annual Convention of the Philippine Sugar Association,* 1926.

The development of manufacturing machinery is a slow process. As the reputation of the manufacturer is at stake when a new idea is tried out, he is very conservative about adopting new ideas unless they have been thoroughly demonstrated in practice. But it is not sufficient that a new device should have proved successful in one particular factory. Manufacturers adopt new ideas only when they have a wide application. It must be possible to sell the new idea to a considerable number of persons in order to make it profitable. It is true that new ideas of necessity originate with the operator rather than with the manufacturer, who must proceed with caution. Sometimes a new idea is apparently successful in one factory, not because of any intrinsic merit in the idea itself, but because the man who originated the device applies exceptional pains and skill to its operation. During recent years, there has been no very radical change in the type of machinery used in cane sugar factories. The Dorr clarifier represents the only important change in the clarification house, and we read very flattering endorsements of the process from those who have installed it. The Kopke centrifugal clarifier which has been in the process of development for quite a number of years at last gives promise of becoming a valuable addition to existing sugar factory equipment. A number of installations of this machine have recently been made in Hawaii. These machines have proved effective in separating from the juices suspended solids which could not be separated by the ordinary means of defecation. The main objection appears to be that the machine requires too much power for the amount of work it does. Engineers of sugar mills in the Philippines have contributed two new ideas which have greatly increased the original capacity of the equipment to which they are applied. These are (1) the addition of water cooling coils to the crystallizers and (2) improvements in the setting of bagasse-burning furnaces. For the water cooling of crystallizers by means of internal coils we are indebted to Mr. Walker.[2] These cooling coils have been installed in the crystallizers of a number of Philippine factories and favourable reports have been received as to their effectiveness in increasing the quantity of low grade massecuites which can be handled by a given crystallizer installation. Doubtless all Hawaiian engineers now in the Philippines have given a great deal of attention to the boiler settings. At least four engineers have introduced innovations in design of bagasse furnaces which have given good results. It seems rather strange that the manufacturers of the boilers have not developed a satisfactory design for bagasse-burning furnaces. This can only be attributed to the fact that engineers who have effected improvements in the design of the boiler settings have failed to bring these improvements to the attention of the manufacturers. During his recent visit to the United States the author heard of plans to use boiler pressures of 175 to 200 lbs. in sugar factories. The use of superheaters in connexion with steam engines and turbines is of considerable value.

The Dorr Clarifier, Petree Process, Peck Strainer, and Crystallizer Coolers in P.I. **William Wylie.** *Reports of the Fourth Annual Convention of the Philippine Sugar Association,* 1926.

At Tilisay Central, P.I., the results obtained with Dorr clarifiers have been "fairly satisfactory," in spite of the fact that the rated capacity of that station was 88 short tons cane per hour, whereas for three months the average grinding rate was 93 metric tons. This offset the efficient operation of the apparatus, although one aimed to maintain a certain mud level in each unit and to handle peak loads by strict observance to juice temperatures, liming, and mud pump control. Following are figures illustrating operations. the process having commenced in 1923-24 :—

[2] *I.S.J.*, 1926, 162.

Cane :—	Crop 1922-23.	Crop 1923-24.	Crop 1924-25.	Crop 1925-26.
Per cent. sucrose	14·52	14·337	12·822	13·164
Per cent. fibre	11·26	10·91	11·34	12·043
Tons per hour grinding	45·67	52·21	79·56	77·09
Dilution per cent. N.J.	21·12	15·38	13·76	17·20
Extraction per cent. sucrose[1]	93·47	93·67	94·85	94·72
Java ratio	83·26	82·11	82·25	80·61
Difference in purities between crusher juice and syrup	0·65	0·95	0·20	0·58
Losses per cent. sucrose in cane :—				
In bagasse	6·53	6·326	5·15	5·28
In press-cake	0·55	—	—	—
In molasses	5·34	5·208	5·98	5·18
In undetermined	0·86	0·221	0·72	0·50
Total losses	13·28	11·755	11·85	10·96
Recovery	86·72	88·245	88·15	89·04
B.H. efficiency	95·93	96·33	98·00	98·07
Factory efficiency	89·01	89·49	93·18	93·24

As far as the Petree process is concerned, Talisay has never had the opportunity of making an exhaustive test, but there is no question that the process is favourable, because of the elimination of mud presses, so expensive to maintain and so disagreeable to operate. Advantages of the Dorr system are : Small factory floor space required ; sanitary conditions ; conservation of heat, simplicity and cheapness of operation. Regarding the Peck strainer there is nothing particularly new to report, but two questions are : How long does the screen last and what kind of material is used? Nothing else but genuine monel metal screen cloth (100 mesh) is being used. One screen if properly attached on strainer cylinder will handle 100,000 metric tons of cane, but great care must be taken on attaching the screen cloth, also when cleaning nothing but hot water under pressure, applied to the outside of the screen cloth should be used. A crystallizer-cooler for low grade massecuite installed at Talisay and tested in March, 1925, has given splendid service throughout the last crop. Tests proved that one water-coil cooled crystallizer will do the work of three air-cooled crystallizers in a period of one week. Massecuites were discharged from pans at 160° F. and cooled to 100° F. in 24 to 30 hours' time, with cooling water at a temperature of 85° F. The capacity of the above crystallizers is 800 cub. ft. each.

RESULTS OBTAINED BY STE. MADELEINE SUGAR CO., LTD., DURING THE PAST FIVE CROPS. *Published at the Seventh Annual Meeting, London.*[2]

	1922	1923.	1924	1925.	1926.
Canes, estate	76,334	74·891	109,336	141,825	162,357
„ purchased	95,551	53,492	59,792	82,894	110,884
	171,885	128,383	169,128	224,719	273,241
Sugar made	17,880	13,739	17,203	23,520	29,365
Fibre in cane	13·11	14·39	14·39	13·91	14·64
Sucrose in cane	11·86	12·60	11·92	11·70	12·27
„ bagasse	3·00	3·14	2·52	2·18	2·11
Purity of juice	80·58	81·79	80·59	81·85	79·73
Recovery of sucrose	84·09	81·08	82·17	86·03	83·95
Yield of sugar, 96°	10·40	10·75	10·27	10.49	10·74
Estate canes, per acre, tons...	18·28	13·98	20·05	19·74	20·58
Price of sugar, per ton	£15/11/7	£25·19/1	£24/14/0	£15/13/4	£14/0/7

[1] Extraction for years 1922-23 and 1923-24 figures on net cane and fibre, later crops gross cane and fibre. [2] See also *I.S.J.*, 1927, 5.

DETRIMENTAL EFFECT OF CANE TOPS ON THE SUGAR RECOVERY. **W. Scott.** *Tropical Agriculture*, 1926, **3**, No. 11, 235.

In order to illustrate the loss caused by the delivery to the mill of improperly topped canes, the following experiments were carried out in Trinidad : Canes with green tops were selected from trucks in the factory yard, the tops (including green cabbage and white joints) being cut off at the base of the sheath. Canes and tops were ground in a laboratory cane mill and analysed separately, the figures for the whole cane, as given below, being calculated from those separate analyses :

	Per cent Sucrose.	Juice. Brix.	Sucrose.	Purity.	Per cent Weight
Tops only	4·17	12·23	5·43	44·39	11·84
Topped canes	12·71	18·20	15·38	84·50	88·16
Whole canes	11·65	17·50	14·39	82·22	100·00

A lower sucrose extraction was obtained from the tops than from the remaining portion of the cane. Allowing for this, but otherwise using figures representing normal factory conditions, it was found that the tonnage of cane required to produce a ton of sugar worked out as follows :—

Cane free from tops .. .. 8·72 tons.
Canes with tops .. .. 10·34 tons.

The tops, representing 11·84 per cent. of the weight of the cane, were responsible for an increase of 18·42 per cent. in the tonnage of cane required to produce a given quantity of sugar. It is therefore evident that the tops, while producing no sugar, cause an appreciable loss of the available sugar contained in the richer portion of the cane.

USE OF THE ISOELECTRIC POINT AS A GUIDE TO THE NEUTRALIZATION OF CONVERTER LIQUOR IN CORN SYRUP (STARCH GLUCOSE) MANUFACTURE. **H. S. Paine and M. S. Badollet.** *Facts about Sugar*, 1926, **21**, No. 51.

" Converter liquor " results from the action on starch of dilute hydrochloric acid at a *pH* value varying from about 1·30 to 2·30,[1] the custom at present being to add sodium carbonate (commonly termed " neutralizer liquor ") to this converter liquor until a definite *pH* is reached. Considerable flocculation of colloidal material occurs as a result of this change in *pH*. Samples of neutralizer liquor received from five different factories producing corn syrup and sugar, varied in *pH* from 3·47 to 5·66. Apparently each factory was " neutralizing " to some definite *pH* value which had been previously determined to be the optimum, possibly on the basis of some test such as rate of settling of the flocculated material. In considering the point to which sodium carbonate should be added in order to produce maximum flocculation, it occurred to the authors that it would be advantageous to give consideration to the isoelectric point. It is known that the electric charge of the particles is an important factor in colloid stability. The neutralization of this electric charge results in aggregation and flocculation of the colloid particles, and this effect is greatest at the isoelectric point ; i.e., at the hydrogen-ion concentration at which the electric charges of the colloid particles are exactly neutralized. Accordingly, a number of samples of neutralizer liquor were tested by means of ultramicroscopic cataphoresis measurements. Some of the liquors were " overneutralized " while others were " under-neutralized." Further investigation of converter and neutralizer liquors disclosed the fact that maximum flocculation of the colloidal material did not take place at the same *pH* value in the samples from different factories or in samples from the same factory taken at different times. Maximum flocculation occurred in all cases at a definite *pH* value (the isoelectric point), but this *pH* value varied with different samples and was apparently dependent upon a number of factors such as character of the raw material, possible conditions of hydrolysis, etc., the significance of which is not at present fully understood. Careful and continuous control of the addition of sodium carbonate to converter liquor is necessary in order to obtain maximum colloid flocculation. This is an important step in the manufacture, and failure to add sodium carbonate in requisite amount at this point may readily cause difficulty at later stages of manufacture.

[1] Hydrogen-ion concentration measurements made electrometrically, using a quinhydrone electrode.

By using an ultramicroscope fitted with a cataphoresis cell it is possible to determine quickly the *pH* value to which any lot of converter liquor should be adjusted by the addition of sodium carbonate in order to produce the maximum flocculating effect. MATTSON has described a convenient ultramicroscopic cataphoresis cell.[1] The authors have described[2] an application of this instrument for the purpose of making an approximate determination of the quantity of colloidal material in raw cane sugar, thereby obtaining an indication of its refining value. Reference is made to this article for a description of the technique and assembly of the apparatus, which can be obtained at a reasonable cost. Irreversible colloids, i.e., those of the type which after flocculation are not re-dispersed on simple addition of water, are as a rule eliminated to a greater proportionate extent than reversible colloids by types of clarification such as that involved in adding sodium carbonate to converter liquor.[3] A recent investigation[4] by the authors of the action of bonechar filters in a sugar refinery has shown that bonechar has a preferential adsorption affinity for irreversible colloids as compared with those of the reversible type. Examination of the bonechar filtrate showed 100 per cent. adsorption of irreversible colloids during the entire filtration and washing period, whereas colloids of the reversible type were not completely adsorbed at any stage and were apparently partially released from adsorption by a change in adsorption equilibrium during the sweetening off and washing of the filters. Colloids of the reversible type are much more difficult to eliminate in industrial processes, and activated carbon is one of the few substances which has high adsorptive capacity for such material. The ideal preparation of liquor for treatment with carbon, therefore, would be the complete elimination of the irreversible type of colloids. The presence of an excessive quantity of irreversible colloids in liquor treated with carbon may result in quickly exhausting the latter and in allowing the major portion of the reversible colloids to remain unadsorbed. Although the ideal point may not be reached in practice, the foregoing considerations emphasize the desirability of obtaining the greatest possible efficiency of colloid elimination at the stage where sodium carbonate is added to the converter liquor.

DETERMINATION OF REDUCING SUGARS VOLUMETRICALLY USING IODINE BY SCHOORL'S METHOD. **M. Van De Kreke.** *Archief, Mededeelingen, No.* 15, 1926, 411-419.

As is now stands, Schoorl's method,[5] a very practical and accurate procedure for the determination of reducing sugars in most sugar factory products, is hardly suitable for molasses, it being difficult sharply to distinguish the colour-change. But the author has found that by a slight modification of the concentration of sulphuric acid, the method can be applied to all cane factory products from juices to molasses, and with results that leave little to be desired in respect of accuracy and rapidity, the *modus operandi* now recommended being as follows: 50 c.c. of Fehling's solution (25 c.c. of blue and 25 c.c. of white liquor) are mixed with 50 c.c. of solution containing the sample, and the flask containing the mixture so heated by a gas flame that boiling point is reached in 3 mins., after which ebullition is continued for 2 mins. longer. After rapidly cooling (but without adding cold water), 25 c.c. of 20 per cent. KI solution and 35 c.c. of sulphuric acid (one part diluted with five parts of water) are added, the iodine thus liberated being titrated with N/10 sodium thiosulphate using starch solution as indicator. A "blank" is carried out using water in place of the 50 c.c. of solution containing the sample, from which figure is deducted that found in the analysis; then the difference multiplied by 6·4) assuming that the thio is exactly deci-normal) gives the mgrms. of copper precipitated as cuprous oxide by the invert sugar present in the solution of the sample used, from which figure the percentage of reducing sugars in the sample can readily be calculated.

[1] *Kolloidchem. Beihefte*, 1922, 14, 309. [2] *I.S.J.*, 1926, 28, 23, 97, 137.
[3] PAINE, BADOLLET and KEANE, *I.S.J.*, 1925, 147-152, *et seq.* [4] *I.S.J.* 1926, 609.
[5] *I.S.J.*, 1916, 334; 1919, 578.

CAUSE OF SWELLING OF CANS (TINS) OF TABLE SYRUP AND MOLASSES. **W. L. Owen.** *Facts about Sugar*, 1926, **21**, *No.* 40, 946-949. Action of torulae is ascribed as the cause. Canning temperatures to be effective must be sufficiently high to sterilize the contents of the can while cooling.—COMBATING RATS WITH CALCIUM CYANIDE. **V. J. Koningsberger.** *Archief*, 1926, **34**, *No.* 26, 669-679. Catching with dogs and coolies is tedious and costly; poisoning by baits and preparations of bacteria and sera fails after a time, as the rats become wary, while asphyxiation methods, using gaseous prussic acid, etc., are highly dangerous. But as effective as the latter poison, and much less dangerous, is calcium cyanide (which on exposure to air generates hydrocyanic acid, leaving lime behind), which is placed in the rat holes and kills off the animals in a few minutes. Granular, not powdered, cyanide should be used.—BAGASSE PRODUCER GAS FOR BURNING LIMESTONE. **T. A. van Haeften.** *Archief*, 1926, **34**, *No.* 18. 463-473. Several writers in Java[1] have advocated the utilization of bagasse as fuel for making producer gas to be burnt under the boilers; but the present author believes that this gas could be used for burning limestone, so as to yield a purer caustic lime (no coke being used) than ordinarily, and at a lower cost for fuel, viz., only 187·5 Dutch florins, compared with 812·5, for a 1000-picul mill per campaign. A gas lower in CO_2 would, however, be obtained.—CAUSERIE ON THE LAFEUILLE CRYSTALLIZER. **M. Lafeuille.** *La Sucrerie Belge*, 1926, **45**, 447-456, 461-469. After discussing in considerable detail the advantages of his crystallizer, the author stated that in white sugar work yields of about 68 per cent. are obtained in 2 to 4 hours, whilst in low grade work only 17 hours are required instead of 4-5 days, a lower purity being reached besides.—IDENTITY OF ISOMALTOSE AND GENTIOBIOSE. **Henry Berlin.** *Jl. Amer. Chem. Soc.*, 1926, **48**, 1107. Evidence is presented that the disaccharide osazone which FISCHER obtained from the syrup representing the unfermentable portion of the product obtained by the action of concentrated hydrochloric acid solution upon *d*-glucose, and named iso-maltose osazone by him, is actually gentiobiose osazone.—PRODUCTION OF FUSEL OIL FROM BEET MOLASSES. **S. Bakonyi.** *Vegyi Ipar*, 1926, *Nos.* 11 and 12; through *Chemiker Zeitung*, 1926, 50, 569. By fermenting diluted beet molasses with *Clostridium butylicum*, a yield of about 18 per cent. of fusel oil, containing 13·5 kg. of butyl and 4·5 kg. of isopropyl alcohols can be obtained.—CLARIFICATION USING CALCIUM CARBONATE. **G. E. van Nes.** *Mededeelingen van het Proefstation*, 1926, *No.* 7; *Archief*, 1926, **44**, 251-256. Louren's proposal[2] to use freshly precipitated calcium carbonate in place of caustic lime for defecation would be too costly. Laboratory experiments now indicate that it may be practicable to regenerate the used calcium carbonate by washing it, suspending it in water, and passing it through a fine-mesh sieve to separate the fine insoluble matter, including *bagacillo*. This regenerated precipitate may be used several times over, though it is necessary for each treatment of the juice to add a little caustic lime to effect neutralization; it is also advisable to preliminarily treat the juice with an acid forming an insoluble calcium salt, as sulphurous or phosphoric acid. It is proposed to try out a process on the technical scale on these lines at the Djatiroto factory, Java.—UTILIZATION OF BEET MOLASSES IN GERMANY. **H. Claassen.** *Die deutsche Zuckerindustrie*, 1926, **51**, *No.* 44, 1170. In Germany during 1925-26 the roots sliced were 10,248,170 tons, and the molasses produced was 382,464 tons, or 3·73 per cent., this being used in the following ways: Desaccharification, 20·11 per cent.; yeast production, 25·29; alcohol production, 9·68; incorporation with dried beet pulp, 6·41; for other fodders, 26·72; for export, 0·39; for other purposes, and remaining over, 11·40 per cent. If German manufacturers as a whole were to agree to restrict their molasses output (using say 10 per cent. themselves as fertilizer) this would improve the market; or they should agree to use more molasses for fodders, which are easily marketed.—POSSIBILITIES OF JAVA MOLASSES. **M. Rups.** *Archief*, 1926, **34**, *No.* 32, 845-856. According to the writer, it should be possible to utilize this by-product for the production of the following: Glycerin, acetic acid (by fermentation, or by oxidation of reducing sugars in alkaline solution in presence of a catalyst), oxalic acid, formic acid and lactic acid. These possibilities are closely considered, and reference to their respective literatures is cited.

[1] *Archief*, 1920, 1349; 1924, 128, 1924, 1363. [2] *Archief*, 1924, 1438.

WIDTH OF BELTING FOR CENTRIFUGALS. **J. Havenstroom.** *Archief,* 1926, **34,** No. 16, 425-426. In most factories for 36 in. and 42 in. centrifugals, belting of 4 and 5 in. width respectively is used. But in the Tjolomadoe factory, Java, belting 1 in. wider in both cases is used to very great advantage. Slipping is reduced to a minimum ; and one can work with thinner, more supple belting, without a reduction of strength. In the named factory there is a 36 in. battery of 4 fore and 7 after-workers and a 42 in. of 2 fore and 6 after-workers, the production of which with 4 and 5 in. belting was 800-1000 sacks, this being now increased with belting of 5 and 6 in. to 1200-1300 sacks daily, which difference is equivalent actually to one 36 and two 42 in. machines.—JUICE DETERIORATION BY BACTERIA. **F. Raabe,** *Archief* (*Verslagen*), 1926, 54-60. If juices are allowed to stand for four hours after milling at factory temperature the loss of sugar in 1st, 2nd, 3rd and 4th mill juices is 1·0, 3·6, 7·5 and 9·0 respectively, and that of the mixed raw juice, 1·9, decomposition therefore proceeding the more rapidly the lower the purity. Sodium fluoride (2 per cent.) is the best chemical to use in the mill, better than formaldehyde. For laboratory tests, the juice should be kept in copper containers, this metal having an inhibiting effect on the deterioration.—H.I.C. STUDIES OF THE CARBONATION PROCESS. **A. H. W. Aten, P. J. H. Van Ginneken and F. J. W. Engelhard.** *Recueil des Travaux chimiques des Pays-Bas,* 1926, **45,** No. 11, 753-771. Measurements of the activity of hydroxyl-ions in sugar-alkali solutions lead to the conclusion that sucrose behaves as a monobasic acid towards alkali and alkaline earth solutions. The conductivity of solutions of sucrose with KOH, $Ca(OH)_2$ and $Ba(OH)_2$ has been determined, the result obtained being inconsistent with the assumption of the complete ionization of the saccharates in dilute solution.—EXPERIENCES WITH BEET PULP DRYING PLANT UTILIZING WASTE FLUE GASES. **E. Weiss.** *Centr. Zuckerind.,* 1925, **34,** 716-719, 740-742. Useful data are given of the "Mulden" dryer (Maschinenfabrik Imperial, of Messen), the cost of which it is claimed will be amortized in 2 to 2½ campaigns.—*pH* OF THE CARBONATION PROCESS. **A. H. W. Aten, J. P. M. van Gilse, and P. J. H. van Ginneken.** *Recueil des Travaux chimiques des Pays-Bas,* 1926, **45,** No. 11, 792-802. It is very doubtful whether the *pH* of the carbonation point is the same as that of the isoelectric points of the proteins present in sugar juices. There is a certain *pH* at which the proteins and their salts show a peculiar behaviour from the point of view of their swelling and ease of filtration. This *pH* has practically the same value as the *pH* shown at the carbonation point, but it is not possible to state to what extent one can speak of an isoelectric point in this connexion, although this peculiar point has certain properties in common with the true isoelectric point.—THEORY OF ACTION OF "CARBORAFFIN." **E. Deisenhammer.** *Centr. Zuckerind.,* 1926, **34,** No. 24, 641-642. It is possible that in the manufacture of this carbon the action of the zinc chloride solution is to dissolve the cellulose of the wood, this sol being later flocculated, so as to give carbon of a very fine state of division. As the carbon named contains much combined oxygen, its effect is due to oxidation of colouring matter rather than to its adsorption, which is the phenomenon accounting for the effect of gas-activated carbons as "Norit." Steam-activated carbons can now be made with decolorizing powers at least equal to carbons made by the zinc chloride process, and with a yield of about 40 per cent.—EFFECT OF ACTIVATED (DECOLORIZING) CARBONS ON THE *pH* OF SUGAR SOLUTIONS. **J. K. van der Zwet.**[1] *Centr. Zuckerind.,* 1926, **34,** No. 44, 1119-1120. Five grms. of various carbons and 100 c.c. of 10 per cent. sugar solution (invert sugar content 0·012 per cent. and *pH* 7·0) were heated for two hours at 90° C., and the invert sugar contents and *pH* determined subsequently with the following results : Bonechar, 0·042 and 6·6 ; "Norit" FNA 0·024 and 6·9 ; "Norit," Supnos grade, 0·030 and 6·8 ; "Norit" Supra grade, 0·036 and 6·8 ; "Carboraffin" (1924), 0·472 and 6·8 ; "Carboraffin" (1926), 1·162 and 6·5 ; "Darco" 0·049 and 6·2 ; "Suchar," 0·024 and 7·0 ; and "Carbo" (Merck), 1·932 and 6·5. Some of these carbons even in the case of the Merck product contained enough acid to give rise to more or less invert sugar formation.

J. P. O.

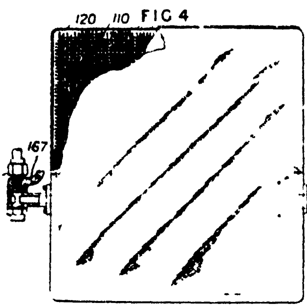
[1] Of Delft, Holland.

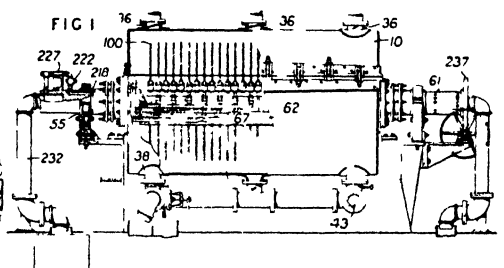
Review of Recent Patents.[1]

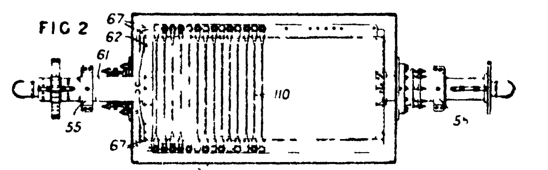
UNITED KINGDOM

FILTERING LIQUIDS (E.G., IN THE "SUCHAR" PROCESS).* **John J. Naugle**, of Brooklyn, N.Y., U.S.A. 261,204. December 14th, 1925.

Filter elements 100 are rotatably supported within the shell 10 on fittings, through one or more of which the filtrate from each element is separately discharged. The shell 10 has upper and lower portions which are pivoted and bolted together. Each element comprises a fabric bag drawn over a metal screen 110, Fig. 4, having a perforated peripheral binding 120, and is mounted by members 150, 167 on a yoke 62 bolted to shafts 61 which pass through the ends of the shell and rest in roller bearings 55. The filtrate passes from the elements through the members 160, and separate pipes 67 connected to passages 218 in one or the other of the shafts 61. Each passage 218 is connected to a common outlet pipe 232 by a valve 222 and a sight tube 227, so that the filtrate from each element can be observed and controlled. Sugar solution or other liquid under treatment is supplied to the shell with a filtering agent, such as activated carbon, through a pipe 43 and valved inlets 38. A circulation is maintained through the shell, unfiltered liquid being constantly withdrawn through outlets 36 and returned to the supply system. The shafts 61 with the yoke and filtering elements are rotated during filtration by worm gearing 237. It is preferred to close to filtration a few of the elements, distributed







in the series, during the filtration proper, and to reserve these elements for the withdrawal at the end of the operation of the liquid left in the shell when the inlets 38 are closed. The elements are cleansed by introducing hot water and steam into the shell while the elements rapidly revolve, and by a reverse flow of hot water through the elements while hot water is directed over the exterior of the elements from nozzles on a longitudinal pipe extending through the shell along one side position of the main valve shown, fluid entering at 18 passes through a passage 30 and through grooves 37^1 in a member 37 fixed to the lower end of the valve 35, to the upper end of the motor cylinder. At the lower end of the stroke of the piston 15, the pilot valves are operated to put ports 48, 49 into communication, so that the pressure fluid passes to a chamber disposed below a piston 36 on the main valve, and raises it to the position shown in Fig. 2, the movement completing the opening of the ports 48, and bringing a plain portion below the grooves 37^1 into a seat 24

[1] Copies of specifications of patents with their drawings can be obtained on application to the following—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price 1s each). Abstracts of United Kingdom patents marked in our Review with a star (*) are reproduced from the *Illustrated Official Journal (Patents)*, with the permission of the Controller of H.M. Stationery Office, London. Sometimes only the drawing or drawings are so reproduced. *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille, du Temple, Paris. *Germany:* Patentamt, Berlin, Germany.

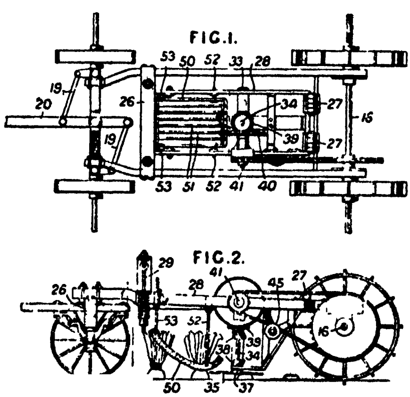
so that the pressure fluid can no longer pass to the upper end of the motor cylinder, which is then connected to the exhaust 31 through grooves 37^1 in a member 37 fixed to the upper end of the valve 35. When the piston 15 reaches the upper end of its stroke, the pilot valves are operated to put the chamber below the piston 36 to exhaust through ports 49, 50, and the main valve is returned. The main valve is provided at each end with a resilient washer 40 adapted to make tight contact with a bead on the seat 24 or 22.

EXTRACTION OF SUGAR FROM BEET MOLASSES BY THE STEFFEN PROCESS.[1] L. **Steffen** (representative of **C. Steffen**), of Vienna. 261,693. January 4th, 1926; convention date, November 17th, 1926.

Tricalcium saccharate of high purity, e.g., 99 per cent. or over, is obtained by washing raw saccharate, produced for example from a molasses or impure sugar solution, with a tricalcium saccharate suspension, prepared by mashing with water or lime-water, tricalcium saccharate, already washed and filtered off under high pressure, to form a dilute saccharate suspension which is then supplied with lime, to reprecipitate from solution the sugar formed by decomposition of the saccharate in the mashing, before its use as a washing liquid. In the process described, the raw saccharate suspension is filtered in a filter-press under a pressure of 2-2½ atmospheres. The washing liquid, which may have a solid content of 5-6 per cent. is then supplied to the press, the solid matter filling up the interstices in the filter cakes and causing an increase in pressure. When a pressure of about 4½-5 atmospheres is reached the washing is terminated. Of the pure saccharate obtained, 25 per cent. may be mashed, etc., to form fresh washing liquid, and the remainder supplied for separation of the sugar.

BEET TOPPER.* **J. Mazocco,** of Gallup, New Mexico, U.S.A. 260,827. February 15th, 1926.

According to this invention, the topping devices of a beet topping machine are carried by an auxiliary frame 28 secured at its rear end by pivots 27 to a main frame and suspended at its forward end by adjustable spring-cushioned hanger rods 29 from an upwardly arched transverse bar 26 extending across the main frame. A U-shaped yoke 33 depending from the auxiliary frame carries an adjustable vertical shaft 34 on which is mounted a rotary knife 35 that is provided with clearing arms 37 adapted to grip and to throw to one side the cut tops. The position of the knife is adjusted by collars 38. The shaft 34 is driven through bevel gear 39, 40 from a shaft 41 connected by chain-and-sprocket gear with the axle 16 of the main supporting wheels of the frame. A jockey pulley 45 maintains the chain taut. The auxiliary frame is moved vertically to position the knife for cutting the individual beets by a frame 50 having its rear end flexibly supported by hanger rods 52 from the auxiliary frame 28 and its forward end by adjustable rods 53 pivoted to the frame 28. Bars 51 extend longitudinally of the frame 50 and engage the beet tops. In a modification the frame 50 is replaced by a transverse shaft mounted in the auxiliary frame and carrying spaced discs adapted to comb through the tops. The wheels of the main frame may be adjusted laterally to suit the width of the rows and the front wheels are connected by links 19 with the pole 20 so that the machine turns with the draught pole.



[1] *Cf.* also *I.S.J.*, 1925, 228, 450, 622; 1926, 116, 500 and 564.

PRODUCTION, APPLICATION, AND REVIVIFICATION OF ACTIVATED (DECOLORIZING) CARBON. (*A*) **K. Bube,** of Halle-Sallo, Germany. 262,278. January 28th, 1926. (*B*) **G. C. Lewis,** of 45, East 42nd St., New York, U.S.A. 262,328. May 11th, 1926.

(*A*) Active carbon in a pulverulent form is produced at low temperatures by heating oils which are normally incapable of being cracked economically, with or without the addition of carbonaceous substances, in pressure-resistant vessels to a temperature of from 350° to 500°C. in such a manner that part of the oil remains liquid during the reaction, simultaneously discharging the liquid, gaseous, and solid reaction products through a common outlet. The pulverulent active carbon obtained may then be submitted to a purifying treatment by means of hot water. In an example, producer gas-tar obtained from lignite is pumped through pipes heated to between 350° and 500°C. at such a speed that carbon does not deposit on the walls of the vessel, volatilization within the reaction tube being minimized by means of throttling-valves. From 10 to 25 per cent. of carbon is obtained in pulverulent form. In a second example, a mixture of powdered lignite with heavy lignite oil is pumped through a tube heated to about 400 to 500 C., and the exit of the tube is throttled in such a way that carbon, oil, ashes and gases leave simultaneously. From 10 to 25 per cent. of the oil, and about 65 per cent. of the lignite are separated out as carbon powder. Crude mineral oils rich in asphalt may be employed in admixture with coal, wood powder, or other carbonaceous substances. (*B*) A filtering element comprises a ceramic container which is filled with activated carbon or other organic char and subsequently burnt to render the ceramic material porous and to increase the activity of the char. The burning operation may be carried out at a temperature as high as 2500°F. Germicides, such as potassium permanganate or copper salts, may be introduced into the carbon or into the water to be filtered. The pottery container comprises a dished disc and a cover, the filtering-element being held between the sections of an outer container, and the filter connected to a service pipe. Or a porous vessel may be packed with carbon and provided with a cover, the element being supported in an aperture in a horizontal partition separating an upper and a lower compartment.

CONFECTIONERY. (*A*) **Clarke, Nicholls, & Coombs, Ltd.,** and **P. C. Howison,** of Hackney Wick, London, E. 261,534. November 9th, 1925. (*B*) **F. B. Dehn (Fair-Play Caramels, Inc.,** of Middletown, New York, U.S.A.). 262,005 June 21st, 1926. (*C*) **H. Bollman,** of Alsterdamm, Hamburg, Germany. 262,239. November 9th, 1925. (*D*) **C. Rost,** of Dresden, Germany 262,309 March 4th, 1926.

(*A*) Relates to the formation of hollow articles, e.g., chocolate eggs, or other plastic materials, in rotary moulds, which are tapped or agitated during rotation. (*B*) A piece of confectionery is moulded into the desired shape, wrapped, and impaled whilst still plastic on a stick which penetrates the wrapper. (*C*) Solubility of cocoa is increased by the addition of a small quantity of phosphatides derived from vegetable materials (e.g., 2 per cent. of lecithin), which is first mixed with a small quantity of the cocoa powder, this then being distributed throughout the mass. (*D*) A machine is described for moulding, and also for causing a longitudinal feeding of the material during rolling. It has one roller formed with one half of its outer surface separated longitudinally, and capable of positive relative longitudinal movement with respect to the fixed half during rolling. The roller may not be divided longitudinally but one-half may be covered by a fixed shield and the roller is positively moved longitudinally with respect to the shield. Further, the movable element may be subdivided transversely each portion having a separate longitudinal motion and each portion being of different length to the others.

CENTRIFUGAL MACHINE CASING. **T. Broadbent & Sons, Ltd. and H. Broadbent,** of Huddersfield. 258,789. March 6th, 1926. The cover is held closed during rotation of the basket by means of a pivoted latch piece carried by a stud on the casing. This latter is moved by a projection or projections on the basket to engage

a slot in a member which depends from the cover. A milled head on the stud enables the latch to be moved away from the member when the machine is stopped.—PRODUCTION OF DRIED MOLASSES. **S. D. Wilkins, H. C. Reiner, and E. C. Gould,** all in Missouri, U.S.A. 257,691. June 15th, 1925. In a process for producing a dried molasses product from liquid molasses by first heating it at a non-injurious temperature to lower its viscosity, and next passing it through a dehydrating apparatus to evaporate it to dryness, a minor proportion of a moisture-proofing stabilizer, preferably skimmed milk solids, casein, blood, egg albumen, or other products of a colloidal nature, for example those from seaweed, is incorporated with the molasses at the first heating. Lowering of the viscosity is preferably effected by treatment at about 190° F. with live steam; and the final dehydration may be continued until a relatively fine powder containing less than 1 per cent. of water is obtained. —SOLIDIFYING LIQUIDS (ALCOHOL, ETC.). **I. G. Farbenindustrie A.-G.,** of Leverkusen, near Cologne, Germany. 259,431. December 29th, 1925. Liquids are gelatinized by the addition of a magnesium alcoholate in presence of a small quantity of water.—PROPAGATION OF YEAST. **International Yeast Co., Ltd.** (assignees of **A. P. Harrison,** of Yonkers, New York, U.S.A.). 259,572. October 5th, 1926; convention date, October 6th, 1925. Apparatus for the propagation of yeast by the process involving the continuous addition of nutrient material to the propagation vessel and the continuous withdrawal of yeast-laden spent liquor therefrom, comprises a number of compartments through which the fermenting liquor passes in succession.—PRODUCTION OF ALCOHOL AND ACETONE FROM ARTICHOKES. **A. P. H. Desborough, A. C. Thaysen and B. M. Green,** of Holton Heath. 259,631. May 6th, 1925. In a fermentation process for the production of *n*-butyl alcohol and acetone from Jerusalem artichokes the fermentation is carried out in a mash, of 20-30 per cent. strength, formed by diluting a 50 per cent. mash after hydrolysis of the carbohydrates therein, as by boiling with 0·2 per cent. of sulphuric acid. ALCOHOL MOTOR FUEL. **I. G. Farbenindustrie A.-G.,** of Frankfurt, Germany. 259,944. October 2nd, 1926; convention date, October 19th, 1925. Motor spirit consists of the usual fuel with an addition of a product obtained by the destructive hydrogenation of carbonaceous material such as coals, tars, mineral oils, distillation or extraction products or residues thereof, or other carbonaceous substances of animal or vegetable origin. Fuels specified include aliphatic benzines of low and higher boiling point, petroleum, gas oil, low aliphatic alcohols as ethyl or methyl alcohol, benzol, heavy oils, and various mixtures thereof.—STRAINING LIQUIDS. **Simon-Carves, Ltd., and A. Robinson,** of Manchester. 260,329. July 20th, 1925. Slimes are passed over a vibrating sieve which has a slower movement in one direction and a more rapid return, which sieve may be inclined and reciprocated by a rotating cam.—USE OF MOLASSES FOR DYEING SILK. **Erste Böhmische Kunstseidefabrik A.-G.,** of Arnau, Czecho-Slovakia. 260,681. August 5th, 1925. Molasses or the residual liquors obtained from the distillation of alcoholic liquors, is added to the precipitation baths used in the spinning of viscose silk.—ROTARY FILTER. **J. A McCaskell,** of Salt Lake City, Utah, U.S.A. 261,218. January 18th, 1926. Liquid is fed to a filter by air under pressure which is also used to force the liquid through the filter, means being provided for maintaining the liquid in the filter at a constant level, for subjecting the filtering medium to a rapid pulsation and for discharging the solid matter, while filtration is taking place, without allowing the air under pressure to escape.

FRANCE

MANUFACTURE OF ACTIVE (DECOLORIZING) CARBON. **P. M. A. Lebeau.** 595,400. June 18th, 1924. Wood, or other such material, is cut into blocks (cubes, prisms, cylinders, etc.); impregnated by prolonged immersion in a solution containing dilute sulphuric acid and a metal sulphate (aluminium, chromium, etc.); and carbonized by raising the temperature slowly to 500-600°C., then heating to 600-900°C., during which stage the metallic sulphate is reduced and carbonization completed.—DECOLORIZING WITH LIGNIN. **International Sugar & Alcohol Co., Ltd.** 596,919. April 20th, 1925. Lignin, obtained by treating cellulosic materials

with acids, is washed, and applied in the same way as wood charcoal for purifying liquids. It should not be dried, though, if this has been done it can be re-activated by steaming.—EXTRACTION OF SUGAR FROM APPLES AND PEARS. *Distilleries des Deux-Sèvres, Soc. Anon.* 596,201. July 12th, 1924. Fruit is subjected to a single or double pressing, and the pulp left treated in a diffusion battery, the juice obtained being worked up by the usual method.—PROCESS OF "HYDROSULPHITATION" FOR BEET AND CANE FACTORIES. **R. Dutilloy.** 595,714. July, 1925. Hydrosulphite (preferably calcium) is added to the raw diffusion or mill juice in determined quantity and at a temperature of 50-60°C. After sulphiting to neutrality a determined quantity of hydrosulphite is added to the syrups obtained from the different crystallizations, or to remelted liquors, this addition being made in an medium neutral to phenolphthalein.—PRODUCTION OF ACTIVATED (DECOLORIZING) CARBON. **E. Urbain.** 603,806. December 24th, 1924. Vegetable matter is extracted with solution of zinc, aluminium, or ferric chlorides with or without the addition of hydrochloric, sulphuric or phosphoric acids. After filtering, it is dried, calcined, washed with hydrochloric acid and again calcined at 800° C. or upwards, when a very active carbon is obtained. Extracts obtained in this lixiviation may be evaporated, carbonized with excess of zinc chloride—or they may be washed free from zinc chloride and carbonized with excess of calcium carbonate, the product resulting forming a very good decolorizing agent.—MANUFACTURE OF ACTIVE (DECOLORIZING) CARBON. **E. Urbain.** 604,181. December 21st, 1924. Activated carbon is made under such conditions that products of different density are obtained which exhibit different degrees of activity toward the same gases and vapours.—MANUFACTURE OF ACTIVE (DECOLORIZING) CARBON. **J. Magtegaal.** 604,417. October 10th, 1925; convention date, October 15th, 1924. Gases from the dry distillation of carbonaceous material, cooled and purified, if necessary, are led from the retorts into a furnace, where they are burned and passed over incandescent carbon.

UNITED STATES.

CONFECTIONERY. (*A*) **Wm. S. Cloud** (assignor to the **Euclid Candy Co.**, of Cleveland, Ohio). 1,608,302. November 23rd, 1926. (*B*) **Roy D. King and Herbert J. Melville** (assignors to **Williamson Candy Co.**, of Chicago, Ill., U.S.A.). 1,608,942. November 30th, 1926. (*C*) **Edward J. Retzbach,** of St. Louis, Mo., U.S.A.). 1,609,199. November 30th, 1926. (*D*) **Leon G. Hamlin,** of Milwaukee, Mis., U.S.A. 1,610,049. December 7th, 1926.

(*A*) A process of making confections consists in continuously moving centres and while so moving first applying a coating of hot viscous material to the centres to render the same sticky: second, without appreciable cooling applying a multiplicity of edible units to the sticky surface of the centres; third, cooling the pieces thus formed until the same are cooled throughout to a temperature below the melting point of the final coating; and, fourth, applying a coating of finishing material. (*B*) A method of applying coatings of nuts to confection centres consists in maintaining a travelling bed of nuts, depositing spaced charges of viscous cementing material on said bed while in transit, then in transit imposing the centres on such charges of material, then in transit depositing covering charges of the cementing material on said centres, then in transit covering the covering charges with nuts, then in transit separating the bed of centres and nuts into individual positions comprising each one centre and a proportionate part of the surplus nuts, and then separately tumbling such portions. (*C*) In the art of making and packaging ice cream in merchantable units or bricks of small volume for delivery to the ultimate consumers, a process comprising flowing the semi-frozen product from a source of supply and while the product is maintained in proper semi-frozen condition, directly into and so as to fill a carton or paper box of a size suitable for domestic consumption, and chilling the product in the filled carton to a hardened condition, substantially as and for the purpose set forth. (*D*) A candy cutting machine includes a cutting means, a movable frame along which said cutting means is movable with respect to the candy, a cam to lift said cutting means after a cutting

operation, a cam to move the frame away from and maintain the cutting means out of interfering engagement with candy being fed upon the lifting movement of the cutting means, uprights to which said guide frame is pivoted, a driven shaft mounted by said uprights, and said cams being disposed on said shaft.

IMPROVEMENTS IN THE MANUFACTURE OF ICING (PULVERIZED) SUGAR. **A. E. Ackers,** of Homebush, Sydney, Australia. 1,605,420. November 2nd, 1926. Claim is made as follows : " In the manufacture of icing (pulverized) sugar, in combination with the process steps of pulverizing, and packaging the sugar, an intermediate step comprising cooling the pulverulent sugar, while unpacked, to dissipate the heat acquired by it through the friction incident to pulverizing"—CLARIFICATION OF TURBID LIQUIDS. **Wilfred E. Langelier,** of Berkeley, Cal., U.S.A. 1,605,596. November 2nd, 1926. A process of separating colloids from turbid water or other liquids, which consists in treating the solution with a coagulant, and thereafter agitating the solution for certain periods successively at different speeds.—TABLE SYRUP. **Benjamin H. Merck,** of Gainesville, Ga., U.S.A. 1,605,754. November 2nd, 1926. Claim is made for the process of producing a coconut flavoured syrup consisting in boiling together equal parts of sugar and glucose with the addition of a small amount of water, placing coconut in the syrup as produced and cooking the same for a short period, adding further water and continuing the cooking, permitting the mixture to stand until the cocoanut butter released by cooking has separated, removing the coconut butter and straining from the syrup the coconut. —ABSORBENT FOR EXPLOSIVES. **Chester Mott and Henry W. Dahlberg,** of Denver, Colo. (assignors to the **Purox Company,** of Denver). 1,606,889. November 16th, 1926. Claim is made for an absorbent for liquid oxygen, for use as an explosive, composed of peat, molasses mixed with the peat, the mixture being dried and finely comminuted, and finely-divided carbon mixed with the aforesaid mixture.—FILTER PRESS BAG. **John P. Hamilton** (assignor to the **Allis-Chalmers Mfg. Co.,** of Milwaukee, Del., U.S.A.). 1,607,619. November 23rd, 1926. A filter-press bag unit comprises interconnected foraminous metallic side walls each having a plurality of pressure-transmittting bars permanently attached to the unit at the wall edges and spaced apart to provide external outwardly open drainage channels directly upon the unit, said bars being formed for co-action with similar bars of an adjacent unit to prevent outward distortion of said walls at said bars and to form unobstructed open ended conduits extending entirely across the adjacent sides of the co-operating units.—ALCOHOL MOTOR FUEL. **Clay M. Hudson,** of Manila, P.I. 1,607,891. November 23rd, 1926. This comprises an admixture of alcohol, acetone, and substantially 1 per cent. of aniline.—FOOD PRODUCT IN SYRUP FORM. **Jokichi Takamine, Jr., and N. Fujita** (assignors to **Takamine Ferment Co.,** of New York, U.S.A.). 1,608,010. November 23rd, 1926. A food product in syrup form has a sweet and palatable flavour and contains sugar and digestive enzymes comprising diastatic and proteolytic enzymes.—CLARIFICATION, USING A FATTY SOLVENT. **Keiicho Seo,** of Kanagawa-Ken, Japan. 1,609,133. November 30th, 1926. Sugar solutions are clarified by acidifying, then adding a solvent of fatty substances immiscible with and lighter than water, agitating, and permitting the mixture to settle, the impurities rising and floating upon the surface of the mixture in a gel form.—MANUFACTURE OF PHOSPHORIC ACID, USING SULPHUR DIOXIDE. **Henry Blumenberg, Jr.,** of Los Angeles, Cal., U.S.A. 1,609,239. November 30th, 1926. A process of making phosphoric acid comprises subjecting finely-ground calcium phosphate in the presence of water to sulphur dioxide under pressure, the quality of sulphur dioxide being in excess of that required to form sulphurous acid with the water.—PRODUCTION OF FIBRE BOARDING. **Joseph R. Coolidge** (assignor to **Montan, Inc.,** of Boston, Mass., U.S.A.). 1,609,642. December 7th, 1926. Fibre board is impregnated for a substantial depth with a melted waxy material which is hard and brittle at high atmospheric temperatures but becomes sufficiently fluid at 275° F. to penetrate into the microscopic pores and cells of fibre board, and subsequently allowing the fibre board so treated to cool sufficiently to cause said material to harden therein.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1927. Tons.		1926. Tons.
Total Receipts, January 1st to January 26th	70,132	..	3,401,618
Deliveries ,, ,, ...	99,736	..	3,282,012
Meltings by Refiners ,, ,, ...	142,000	..	3,262,682
Exports of Refined ,, ,, ...	200	..	86,000
Importers' Stocks, January 26th	97,659	..	128,262
Total Stocks, January 26th	135,114	..	188,552
	1926.		1925
Total Consumption for twelve months	5,671,335	..	5,510,060

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR,
1924, 1925, AND 1926.

(Tons of 2,240 lbs.)	1924 Tons		1925 Tons		1926 Tons
Exports	3,736,359	..	4,650,474	..	4,433,228
Stocks	145,422	..	292,119	..	225,593
	3,881,781		4,942,593		4,658,821
Local Consumption	115,000	..	135,000	..	145,000
Receipts at Ports to November 30th	3,996,781		5,077,593		4,803,821

Havana, November 30th, 1926. J. GUMA.—L. MEJER

Sugar Crops of the World.

(Willett & Gray's Estimates to January 13th, 1927)

	1926-27. Tons.		1925-26 Tons.		1924 25. Tons
CANE.					
America	8,343,500	....	8,666,365	....	8,877,329
Asia	6,021,957	..	6,254,484	....	5,661,027
Australasia	510,000	. ..	612,344	....	536,490
Africa	617,000	....	679,387	....	545,260
Europe..................	7,500	....	9,000	....	8,087
Total Cane..........	15,499,957		16,221,580		15,628,193
BEET.					
Europe..................	6,862,000	....	7,441,441	....	7,083,068
U.S.A..................	810,000	....	804,439	....	974,185
Canada..................	28,000	....	32,475	....	36,200
Total Beet	7,700,000		8,278,355		8,093,453
TOTAL CANE AND BEET..	23,199,957		24,499,935		23,721,646

United Kingdom Monthly Sugar Report.

Our last report was dated the 11th January, 1927.

During the last few weeks under review prices generally have had a setback and the whole trade has been very quiet.

The London Terminal Market has continued to be active and the registrations have been above the average, principally in the old crop deliveries. The principal feature has been the unexpected hedge selling of May paper against the unsold portion of Home Grown, and also similar operations in October/December against Home Grown. Outside speculation has continued on the long side but the recent decline has caused the liquidation of a considerable amount of March which has been in some cases transferred to later months. Only small quantities were tendered in January and this month was finally liquidated at 17s. 9d. March moved from 18s. 11¼d. to 17s. 11¼d. to 18s. 6d. to 18s. 3d. May sold from 19s. 0¾d. to 18s. 6d. to 18s. 11¼d. to 18s. 2¼d. to 18s. 10½d. to 18s. 6¾d. August sold from 19s. 3d. to 18s. 7½d. to 19s. 2¼d. to 17s. 4½d. to 19s. 0¾d. to 18s. 9¾d. October sold from 17s. 9d. to 16s. 7½d. to 17s. 4½d. to 17s. 2¼d.; and November/December from 17s. 4½d. to 16s. 4½d. to 16s. 10½d. to 16s. 9d. The latest prices are February 18s.; March 18s. 3d.; May 18s. 6¾d.; August 18s. 9¾d., October 17s. 2¼d.; and December 16s. 8¼d.

Actual sugar has been very dull and the demand from the trade throughout the period under review has been exceedingly small. January is usually a poor month for consumption but this month has been exceptional and it should be evident that the demand will be much heavier during the next few months in consequence. Czecho Granulated has been very scarce and has never been pressing, ready f.o.b. Hamburg has been traded in from 19s. 6d. to 19s. to 19s. 1½d., and April/August from 20s. 3d. to 19s. 9d. There has been an ample supply of Dutch Granulated for ready from 19s. 6d. to 18s. 10½d. to 19s. 3d.; April/June from 19s. 9d. to 19s. 1½d. to 19s. 4½d. American and Canadian Granulated was offered from 20s. 6d. down to 19s. 10½d. c.i.f.; Spot Granulated moved from 32s. 3d. to 31s. 4½d. to 31s. 10½d. duty paid.

It has been very difficult to sell Home Grown and prices have been reduced from 33s. 3d. and 33s. 9d. to 32s. 3d. and 32s. 9d. respectively, and a fair business has been done at this lower level.

The British refiners—owing to the raw position—were reluctant to lower their prices, but owing to the accumulation of white sugar they were forced to reduce their prices 6d. per cwt. on January 15th, and on January 26th a further decline of 6d. per cwt. was registered. The latest prices are No. 1 Cubes 37/3, London Granulated 33s. 1½d. duty paid.

Raw sugar has never been pressing for sale, but on the other hand our refiners have not been anxious buyers. Cuban 96 per cent. sold in small quantities from 16s. to 15s. c.i.f., but a fairly large quantity was taken recently at 15s. 1½d. To-day's price is 15s. 6d. c.i.f. Continental countries also bought in the neighbourhood of 15s. 3d. to 15s. 4½d. c.i.f.

In New York there has only been a very small demand for raws from the refiners in consequence of the very meagre demand from the trade. Cubans sold down from 3⅜ to 3⅛ c.i.f. New York, and the latest price is 3 3/16ths. Porto Ricos and Philippines have been sold in America in good quantities. The Futures market is about 15 points lower than a month ago.

Mr. F. O. Licht has made no further alteration in his estimates, so it can be assumed that the total of the European crops is 6,840,000 tons. With regard to Cuba, the President has again reiterated that under no circumstances will the crop exceed 4,500,000 tons. The receipts to date are 634,000 tons against 924,000 this time last year, and the stock at the ports is 401,000 tons against 446,000 tons in 1926.

21, Mincing Lane,
London, E.C. 3.
8th February, 1927.

Arthur B. Hodge,
Sugar Merchants and Brokers.

THE INTERNATIONAL SUGAR JOURNAL.

☞ All communications to be addressed to "The International Sugar Journal," 2, St. Dunstan's Hill, London, E.C. 3.

☞ The Editors are not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

No. 339. MARCH, 1927. Vol. XXIX.

Notes and Comments.

The Outlook.

The home-grown beet crop has now been nearly all marketed, and is estimated at 148,600 tons expressed as refined. Incidentally, with the gradual disappearance of this competition from the market, the TATE & LYLE refineries have been able to resume operations and are now all at work again. Messrs. CZARNIKOW put the consumption during 1926 of home-grown beet at 129,318 tons, as compared with 36,725 tons in 1925, and, adding these to the consumption of foreign sugar, they estimate our total consumption for 1926 in raw value at 1,906,229 tons as compared with 1,854,594 tons in 1925, an increase in consumption of 51,635 tons, which may be considered very satisfactory in view of the fact that the prolonged coal strike led to much extra unemployment.

Indications all point to the belief that in the coming months consumption is going to exceed production, and consequently there will be a drain on the existing reserves. LAMBORN & Co., of New York, have issued some figures on this statistical position; they estimate the world's sugar production during 1926-27 at 24,347,000 long tons, a reduction of 2·5 per cent. over 1925-26, while the consumption they put at 24,881,000 tons, an increase of 2·3 per cent. over 1925-26. The quantitative advance in the world production is thus arrested, for the first time since 1919-20. Sugar production is however expected to continue its progress, though at a lesser rate than in recent years. Stocks are accordingly estimated by these statisticians as being reduced at the end of August next by 534,000 tons, as compared with stocks in hand on September 1st, 1926.

The Cuban campaign got into full swing once the New Year arrived, and latest reports indicate that the arrears as contrasted with the same date last spring will soon be wiped out. The centrals were unable to agree amongst themselves as to the allocation of the crop, so in the end the President through his official departments settled the distribution. Opinion has been divided in the sugar world as to whether the Cuban authorities would persist in the end in restricting Cuban production to the statutory four and a half million tons; but while it is not impossible that towards the end of the season the change in the sugar position may tempt them to relax their restrictions, the Cuban Government have so far shown a firm front in carrying

out their proposals, and have increased the fine leviable on infractions of the law as to individual factory outputs. Some districts may, it is true, not be able to turn out quite all they are allotted, in which event other producers may be allowed to scale up a bit; but the total crop aimed at does not deviate from the maximum laid down by recent legislation.

The British Refiners' Case.

On another page we give a paper from the pen of Sir FRANCIS WATTS, K.C.M.G., on the British refiners' case against home and foreign competition, as viewed by West Indian interests. It is always useful to learn the point of view of the other producer and for this reason we are glad to give so distinguished a West Indian savant as Sir FRANCIS WATTS an opportunity of putting forward the views held by sugar producers in that quarter of the Empire. But we feel bound to observe that he seems rather predisposed to assume that the refiners' case—against home grown beet in particular—is justified up to the hilt and that nothing remains to be done but to find a solution that will at the same time leave West Indian interests unaffected. The bulk of the paper is in fact taken up with the pros and cons of a recent statement of the refiners against the competition of home grown beet sugar, Empire washed sugars, and foreign refined, at the same time briefly outlining certain West Indian objections to possible lines of remedy. But in our view one or more of these competitors has a much stronger case than seems to be assumed, and any completely equitable solution of the problem is decidedly difficult to effect.

There is no doubt that the refiners are suffering from a degree of competition unsurpassed since the palmiest days of the Continental bounties when foreign refined was dumped freely on these shores. The war gave them their opportunity, inasmuch as it cut off at one fell stroke the imports of their principal rivals and carved out new channels for the importation of refining raws. But the war also impressed on us the politico-economic lesson that while giving sugar its finishing touches in this country might be good for our industrialists as far as that went, the production entirely overseas of our total sugar consumption was not good for the consumer; so steps were rightly taken to remedy that defect, and sugar beet cultivation was added to our system of agriculture. Since the entire history of beet sugar production had shown that a new industry of this kind could not be established without fiscal aid, it was inevitable that the Government should agree to aid it by means of a subsidy which was fixed to last for a term of years in periodically declining amounts. But for this subsidy no capital, it is safe to assert, would have been forthcoming to erect the fourteen or more factories now existing or projected; no terms could have been offered to the farmers sufficient to overcome their innate conservatism to changing their agricultural practice by including a new and unknown unit in their rotation of crops; the experiment would have had a brief and spasmodic existence and have died out speedily, just as previous attempts had done. But thanks to the subsidy the new experiment has been having a fair trial, has caught on amongst all progressive farmers, and while it is not yet a foregone conclusion that it will ultimately be able to exist without fiscal aid, the outlook after only three seasons is hopeful rather than the reverse and justifies the attempt being persevered with.

The results of course are various and cannot satisfy everybody. There is no doubt that the new cultivation is proving of great benefit to home agriculture (as is shown in our quotation below from a report in the *Times*

by its Agricultural Correspondent) and this is a point that must carry considerable weight in home circles.[1] There can be no reason why this country should remain the sole exception to the rule holding good in all countries of the temperate zone that some at least of the requirements of the population in sugar should be produced at home and not imported. So it is all to the good that we who can consume over 1¾ million tons of sugar annually should produce some of it within our own borders and to that extent be independent of outside competition. Various estimates of our home capacity for production have been made from time to time, but half a million tons seems to be the outside figure. This year we are in the neighbourhood of 150,000 tons, and to that extent other producing sources in the world are bound to suffer.

Sugar Production in One Stage or Two.

But the refiners argue that the sting in the subsidy lies in the fact that it does not stop at the raw stage but rises through polariscopic stages to fully refined. Confine it to the raw stage, they ask ; and then these factories would presumably content themselves with turning out raws only, which would need to be transported to one of our coastal refineries to be remelted and turned into refined ! But would they, it is legitimate to enquire ? Scientific research has solved for beet sugar more completely than for cane the problem of turning out practically refined sugar in one stage at the beet factory, and it is idle to suppose that the promoters of these factories who have been able to fit them up on the most modern system will prefer, subsidy or no subsidy, to turn out anything else than the best qualities of sugar. Even if they gain nothing from the subsidy by doing so, they must take the long view that, science having come to their aid as it has, it is to their advantage to make the most of it—both now, and in the future when conceivably they may have no further fiscal aid than the preferential excise duty. For this reason there is everything to be said for the attitude of the Government in doing nothing that would be calculated to hamper these experimental factories from achieving their utmost aim. That the refineries have this past season found themselves faced with the competition of some 130,000 tons of ready-made home sugar is an unfortunate incidental of this policy ; but the latter is only part of a world-wide re-shuffling of values in which our refineries are being pushed back by contending forces that are bound to increase rather than the reverse. Principally contending is the march of science in the cane sugar industry of the tropics where direct consumption sugar is (more slowly than beet but not less certainly in the end) endeavouring to establish itself as the standard of production. Against this onslaught it is difficult to see how refining as a separately located and separately conducted process can hope to compete successfully. Hence the subsidizing of home grown sugar is not the most threatening piece on the chess board, though it may at the moment be the most prominent.

The refiners, however, complain also of the competition of foreign surplus refined sugars entering this country. There they have a grievance that is legitimate and certainly calls for redress in view of the general economic policy postulated by Imperial preference. But, as we have before pointed out, the remedy runs counter of certain political opinions held in this country, and a similar good case could be made out for protecting many another home industry that suffers from the competition of the surplus products

[1] *Pace* Sir FRANCIS WATTS, we venture to suggest that the British public do now appear to grasp the place of this industry in the national economy.

of foreign manufacture. Personally, we are fully in favour of granting such protection; but whether the Government can devise a method of relieving the refiners, without embarking on a distinct incursion into the realms of Protection generally, remains to be seen.

The Position of Empire Cane Sugar.

Sir FRANCIS WATTS in his paper elsewhere admits that the refiners have never had the monopoly of sugar production, inasmuch as a certain amount of direct consumption sugar has always been produced in the West Indies and elsewhere. He argues however that tropical sugar producers will always look to the refineries to take the bulk of their output; and he therefore looks with favour on the suggestion that the duty on refined sugar imported into the United Kingdom should be increased, so as to protect the refiners' sphere of operations. But when he goes on to suggest that a feasible definition of "refined" is sugar polarizing 98° or over, it becomes necessary to point out that while this would leave untouched West Indian grocery sugars which usually polarize under that figure, it would penalize a number of plantation whites from other parts of the Empire which represent more modern methods of manufacture and polarize well over 98°. If it is possible to protect the home refiner from the invasion of cheap foreign refined sugars, that would appear to be the most that can be done, without stultifying the efforts of Empire producers of sugar, both at home and overseas.

As for the present competition of home-grown beet with Colonial cane sugar, it appears to us sufficient to remark here that it is questionable whether any subsidy offered to our West Indian sugar industries could have produced within three years an increase of 130,000 tons of sugar. The scope for further expansion in these sugar regions is by no means great, and the opening up of new cane territories is a matter of much more time and organization than is the expansion of beet sugar production on our own country side at home. This last is a new feature which has come probably to stay and its competition will have to be reckoned with. With the preference to help it, Empire cane sugar ought not to have any difficulty in maintaining its position on the home markets as one of our standard sources of supply, but it can no longer expect the home country to be content to import all its requirements in sugar even if Empire grown, for it is becoming increasingly clear that a new system of home agriculture which has received the approval of more than one political party will be tried out to the utmost and if feasible will become a standard feature in our food crops. The general feeling in its favour is too strong to be discounted.

The *Times* on the Beet Industry.

As showing the general view held in agricultural circles the following excerpts from an article in the *Times* by its experienced Agricultural Correspondent are worth quoting. "The sugar beet industry (he wrote) has been prominent in the public mind in the past few weeks. The agricultural community, in its eager search for a way out of the industrial deadlock, has been studying minutely the merits and risks of the pursuit, while the section of the great business world particularly interested in the manufacture of home-grown sugar has also been scrutinizing closely the economic possibilities of this important outlet for capital. In addition, the general public have had their attention directed to the enterprise through Parliament, so that the recent survey has been broad, if not always impartial or sym-

pathetic. The position of the new industry as revealed . . . . is extremely encouraging. The progress that has been made in the past few years is creditable to all who have been instrumental in bringing about the development—successive Governments, business firms, and farmers. The present state of the industry if it could be maintained would be of the greatest service to farming, and would go far to ensure that arable husbandry would continue on an undiminished scale, or be increased. With a root crop that is immediately convertible into money to serve in the rotation as a variant to cereals, clovers and grasses, and in suitable circumstances as a substitute for the roots for consumption by cattle or sheep, the position of the farmer is made appreciably stronger . . . . The financial side of the industry may not yet have emerged from the experimental stage. The critical period in the trials has been reached, however, and with the State aid decreasing as the experience of the farmers and factory companies extends, the test will be complete before the term of Government help terminates. The full period of ten years should see the business established on a sound and enduring footing, and if this result should be achieved it will, I believe, excel any comparable accomplishment on the Continent. The results, so far as they have been ascertained, throw an interesting light on the adaptability of the soil and climate of this country for the cultivation of sugar beet, and the resourcefulness of our farmers in tackling new enterprises . . . . The yield of roots was usually satisfactory and the sugar content in the roots exceeded the most sanguine expectations . . . . The summer of last year was about as sunless and cheerless as any within recent memory, so that it would be contrary to reasonable calculation to attribute the high sugar content to the influence of the sun . . . . Taking all things together it would seem to be fair to assume that increased experience, and the intelligent application of its teaching, more than anything else, brought about the gratifying results obtained in 1926. Farmers have been quick to perceive and to grasp the essential requirements of their crop; and losing no time in putting their improved knowledge in effective use, they have coaxed from their land in a sunless season crops remarkable alike for their bulk and their quality.

"It would be a mistake, however, to assume that the complexities of the crop have been completely mastered. There may still be much to learn and the experiences of coming years will, it may be hoped, reflect continued progress in the interpretation of the fundamental principles and the adoption of sound practice in the cultivation of sugar beet."

German Sugar Combines.

According to HUMBERT of Magdeburg, the combine of German sugar factories and refineries which has been in existence for some years has lately come in for criticism, and the question is being asked whether under present circumstances the disadvantages do not outweigh the benefits. This combine originated after the war when many factories found it difficult to surmount their financial difficulties unaided, and by combination amongst a number of the factories much overhead expense was saved. But latterly it has been found that factories outside the combine have obtained higher prices in consequence of competition amongst the refiners, have got their money sooner, and have been able to profit much better by the market chances; so some uneasiness has been caused amongst the members of the combine, and a re-consideration of the whole question has been demanded. A leading advocate against the combine is said to be Mr. WEIDNER of the

Centralblatt für die Zuckerindustrie, who has always been a strong supporter of the provisions of the Brussels Sugar Convention; he characterizes these combines as unthrifty and as interfering with the re-establishment of the German terminal markets. But as the firms in the combine have bound themselves for a considerable time, it is difficult to see how the previous position could once more be reverted to; at the same time, it happens that some of the members of the combine have already managed to withdraw, so further developments in this direction are not impossible.

Prospects of the German Beet Campaign.

The same statistician reports that in well-informed circles in Germany a 5 per cent. increase in the beet sowings is considered a rather conservative estimate. The trouble experienced last year with the field workers has of course a discouraging influence on present prospects, especially as the prices for other agricultural products have improved and will offer increased competition for the supply of labour. On the other hand, it is confidently anticipated that the new Government will increase the import duty to Mks. 7·50 per 50 kg. The admission of foreign labourers to the beet fields—an important factor in gauging results—is expected to be settled soon in favour of the farming interests; but for the time being the number admissible is put at 100,000 as compared with 130,000 last year. Till it is known whether this number can be increased or not, negotiations for beet sowings are carried out under difficulties, so the preliminary estimates reflect only general impressions as yet.

Payment for Beets in Italy.

The standard of payment for beetroots in England is on a considerably higher scale than it is amongst Continental growers, and it is by no means certain that the present degree of disparity can be permanently maintained in the face of competition. Anyhow, the standards abroad would appear to be by no means displeasing to the growers concerned. As an instance of what is done in Italy, the latest arrangements between the sugar factories there and the Italian federation of beetroot growers may be cited. The roots are of course paid for in accordance with their sugar content, which represents the industrial value; and out of the price obtained from the sugar extracted, 44·5 per cent. will be retained by the factories per 100 kg., and 55·5 per cent. by the cultivators per ton of roots of an average polarization of 14 per cent., which corresponds to a yield of 10 per cent. The beets will be paid for proportionately more or less, according as their polarization is above or below 14. Thus, if the price of sugar, exclusive of the manufacturing tax of 400 lire, is fixed at 270 lire per 100 kg., then 120·15 lire are retained by the factory per 100 kg. of sugar produced, and 149·85 lire go to the beet growers per ton of beets having 14 per cent. polarization. Every degree more or less of polarization would therefore mean a difference of 1·07 lire in the payment to the growers. This method of payment, it may be added, came into force first in 1926, and at the start did not meet with general favour as it was thought to be of too complex a character. But after one season's trial, it was everywhere accepted favourably, especially as the other crops competing with beetroot did not offer very remunerative prices to the farmers.

The Italian sowings this year are expected to show an increase of 30 per cent. over 1926, or 110,000 hectares, as compared with 80,000 in 1926; with this area Italy's requirements in sugar, calculated at some 325,000 tons, will probably be met.

Notes and Comments.

The Outlook in British Guiana.

The *Times* last month had a leading article on British Guiana, inspired by the fact that two British Members of Parliament, one a Conservative, and the other a Labour man, had just returned from a trip to that colony at the request of the Colonial Office, to report primarily on any steps that might be taken to make better use of the economic resources of the colony. Our contemporary took the opportunity to outline some of the difficulties that are met with in achieving this desirable result.

The immediate prosperity of British Guiana turns upon its sugar. There are big possibilities with regard to timber (for nearly 90 per cent. of the whole territory is forest) while rubber growing also offers advantages. But sugar remains, as it has always been, the staple commodity of British Guiana and the arbiter of its prosperity. The history of the colony has been dominated by the question of labour for the sugar plantations ever since the abolition of slavery nearly a hundred years ago. The longest and most important of the labour experiments, the indenture system, which brought a large population from India, was finally stopped a few years ago by the action of the Indian Government. The labour outlook is uncertain to-day, but for the moment the future of the main industry of British Guiana is uncertain also. The British preference while it has proved an invaluable help has also stimulated the products of Queensland and Natal which have entered the United Kingdom market. British Guiana also suffers from the handicap of lacking large-scale capital improvements, such as are a feature of other sugar territories; there is this lack of new capital because there is a final uncertainty for sugar-growers in the political state of the Colony. This, according to the *Times*, is due to the peculiar constitution enjoyed by the colony, government being partly by officials and partly by elected members. "The result has been friction between the Government and the elected members, that is the lawyers or traders who have secured the miscellaneous native vote. Of late years the friction has become acute, and there has been a marked decline in local political standards." The conclusion drawn is that British Guiana will continue to be handicapped, till there is renewed confidence in the security of investment there.

Errata.

Two or three slips which have occurred in recent issues of this journal call for correction. On page 633 of our December issue, line 9, the year given as being the date of the Philippine crop under review should have been "1924-25," not "1925-26" as printed.—In the same issue on page 639, line 15 from bottom, "pound" should have read "round."—On page 64 of February, line 10 from top, the year "1903" should obviously have read "1893."

The final general forecast of the 1925-27 Indian cane sugar crop estimates the area sown at 2,920,000 acres, as against 2,679,000 acres last year, an increase of 9 per cent. The total yield of raw sugar (*gur*) is estimated at 3,208,000 tons, as compared with 2,977,000 tons last season, an increase of 8 per cent. Weather conditions have generally been favourable, and the condition of the crop on the whole is reported to be good.

A Committee on National Debt and Taxation which has just issued its Report after nearly three years of investigation, remarks incidentally that, as distinguishing between duties on luxuries and duties on necessaries, the Committee thinks that "the sugar duty is relatively high, even in the financial needs of the time." But with the loss of revenue experienced by the country as a result of last year's disastrous coal strike, it may be doubted whether the Chancellor of the Exchequer can afford to take the hint in his next Budget which is down for April.

The British Sugar Beet Society.

Recent Progress and the Future Outlook.

The Report of the Committee of the British Sugar Beet Society, Ltd., for the year 1926 lately issued, reveals a tale of steady progress and varied activities in its twelfth year of existence.

The year saw four new factories erected in this country, thus bringing up the number completed to fourteen. The factory scheme for the West of England, however, which the Anglo-Dutch group had in contemplation, could not be proceeded with. Four alternative sites were considered, but in the end all proved unsuitable, either from insufficient assurance of acreage, or from technical difficulties such as the disposal of effluents. This last obstacle has in fact had to receive considerable attention of late, it having had the effect of arresting the erection of more than one factory ; and the Society was invited by the Ministry of Agriculture to co-operate in an investigation of the problem. A special Factory Effluent Committee was appointed, composed of resident technical officers of the factories, and a technical adviser has carried out investigations on their behalf. It is hoped that as the result of this scheme of co-operation amongst the factories and the pooling of experience, improved methods may be devised to avoid future difficulties.

The factory results, as revealed by a Parliamentary White Paper, showed that only some of the new factories had worked at a profit in 1925, thus demonstrating the high cost of initial experience and organization. On the other hand, there is already evidence to show that the results of the 1926 season may prove to have been more favourable in all material respects. Reports from farmers indicate that they have been satisfied with the results of the last crop, and much additional experience has been accumulated. The high quality of the roots has been a notable feature of the past year.

During the year in question, a visit of inspection was paid by members of the Society to sugar beet estates in Germany to investigate the methods of growing beet for seed. Valuable information was gained, both on the particular subject of seed raising and with regard to the sugar beet industry generally in Germany. At home a large number of trials have been held to demonstrate the lifting of beet crops by mechanical devices, and have proved a valuable means of bringing British manufacturers of agricultural machinery who have studied the question into direct touch with the farmers and their requirements.

The usual amount of general propaganda was undertaken during the year, lectures both technical and popular being delivered in various suitable centres. There has been a steady demand for the Society's literature, and a large correspondence in connexion with general public enquiries has been undertaken.

But with the resignation by Mr. Alfred Wood, the Secretary, of a position he has occupied since the inception of the Society, an opportunity has arisen for considering whether having regard to the present position of the development of the sugar beet industry, the results achieved, and the work now being undertaken by the various bodies interested in the several aspects of the subject, in particular the National Farmers' Union, the pioneer work for which the Society was formed has not been accomplished. A Committee of the Society are therefore proposing to review the whole position in the light of present conditions, and indications rather point to the belief that the Society as a separate entity may be wound up. Mr. Wood has consented to remain in office till a decision has been reached.

The British Beet Sugar Subsidy.

Debate in Parliament.

On February 15th and 16th a debate took place in the House of Commons on the beet sugar industry, occasioned by the fact that amongst a number of supplementary estimates that had to be passed was one for £450,000 required for the subsidy on sugar and molasses manufactured from beet grown in Great Britain. The original estimate as passed by Parliament was for a sum of £2,750,000, but this having proved inadequate a further supplementary sum was now asked for by the Government. A numbers of members attempted to profit by the occasion to criticize the principle of subsidies, but they were ruled out of order by the Chairman on the score that the House had agreed to the principle of a subsidy in the original debate and this supplementary vote did not allow the argument to be re-opened. As a consequence, the debate was carried on under considerable difficulties, and even the Minister of Agriculture was called to order for going beyond the limits of discussion allowed.

Mr. Guinness, the Minister for Agriculture, in presenting the vote, explained that it was necessary because during the current season a very high rate of production had been reached in the fields, and a greater yield —about an extra ton per acre on 130,000 acres—had been obtained. The demand of the factories on the subsidy had also been increased by the better sugar content of the crop, which this year was estimated at about 17 per cent. as against 16·3 last year. This year the season had been very good and very little damage had been done by frost. The vote was indeed evidence of the success of the policy to help the beet sugar industry which was adopted with the general agreement of all parties.

Mr. Buxton, the Labour member for N. Norfolk, who supported the passing of the Vote, said that the acreage under beets had gone up since the passing of the Sugar Act from 16,000 to 130,000 acres, and at present the country was itself supplying about five weeks of the sugar consumption. However, the really vital question was, what prospect was held out of ultimate success for the industry. The most helpful thing the Minister of Agriculture could do in his opinion was constantly to urge on the factories and the farmers that he would help them in every conceivable way to increase their efficiency so that they would be able to face the world at the end of the subsidy period on the basis of free competition standing on their own legs. Here and there, he added, production was already extraordinarily good, and he did not suppose the Dutch or the Germans could readily surpass the results obtained by a farmer in Suffolk who grew an average of 18 tons to the acre with a yield of 17 per cent.

Sir George Courthope, who followed in the debate, speaking of the improvement already effected stated that he knew of many farmers who a few years ago were producing 5, 6, or 7 tons per acre of second-rate beet, but now were obtaining 14, 16 or even 18 tons per acre. It was a justification for the subsidy that the tonnage per acre was a full ton more this year than estimated. There was one year more of the full subsidy to go and then it would drop 6s 6d. per ton of sugar. That drop, converted into terms of raw material of beet, meant on a 15½ per cent. basis, approximately £1 per ton of beet delivered at the factory. Speaking as himself a beet grower he considered that the experience of the year proved beyond all doubt that the farmer who was growing beet with proper methods on suitable land was well able to bear a full share in the inevitable fall in the subsidy. He trusted that the progress shown by the farmers during the last five years

would be continued so that four or five years hence by which time the second drop in the subsidy was due a still better crop would be obtainable than was the case to-day.

Various members who took part in the debate either approved the vote or criticized the principle of a subsidy; questions were asked as to the effect of the industry on arable land, on labour wages, on small holders; while the effect on the Thames-side refineries of the competition of home beet sugar was referred to. One member usefully reminded the House that while the Government paid out a subsidy with one hand, they collected an excise duty with the other, so that the net payment was not as great as it seemed.

Mr. GUINNESS in a final reply to questions and criticisms said that a great risk was taken by those who put up the money for the beet factories, and there could be no question of depriving them of the subsidy on which they had counted. Even with the subsidy to help it, one factory had made a loss of over £60,000 last season. Touching on the payment of labourers, he said the standard wage could not be raised when but 2·1 per cent. of the cultivated area was under beets; but in the beet districts workers were earning from 40s. to 50s. a week in this seasonal work—thinning, singling, and hoeing—a wage much in advance of the standard. In Canada wages were higher than in this country, but there the yield of sugar beet had reached 11 tons per acre on the average, as against the 8·7 tons here, which was expected to be achieved this season. In 1925 we got a yield of 7·8 tons per acre, with a sugar content of 16·56, while this year's content is expected to be about 17. Holland, which he stated to have the highest yield of any country, achieved 13·4 tons in their last published statistical year. Dealing with the employment resulting to the engineering trade, Mr. GUINNESS said no more exemptions had been made from the rule laid down in the Sugar Act that 75 per cent. of the machinery had to be produced in this country. At the time the Act was passed two already planned factories had placed contracts for machinery, partly abroad; but even there the total of British machinery employed was 77 per cent. of the whole. In the 10 other factories that have been erected under the subsidy the amount of British made machinery was 89 per cent. of the whole.

Questions having been asked about the De Vecchis process, Mr. GUINNESS replied that the British rights in this process were presented to the Government. Experiments on this system have been carried out by Professor OWEN at the School of Agricultural Engineering at Oxford. The De Vecchis process was also tested at a small scale factory built by the Government at Eynsham. The experiments having been concluded, that factory has now been sold to a company formed to manufacture sugar by a new process. The Eynsham factory is not working on the original De Vecchis process but is using additional discoveries which Dr. OWEN has recently made at Oxford. Obviously, however, it would not be right to express any opinion as to the prospects of success of the process until it has been tried out on a larger scale.

The death is reported at Havana, on January 31st, of Mr. H. A. HIMELY, the well-known Cuban sugar statistician. The *Federal Reporter* in an obituary notice remarks that "his integrity and honesty of opinion were such as to give his crop estimates great weight. A Christian gentleman, his deep religious convictions were exemplified in his business no less than in his private life. His unfailing courtesy to all with whom he came into contact, and the quiet forcefulness of his character, earned for him the deep affection of those who were so fortunate as to be his friends." Mr. HIMELY was in his 77th year.

The Nematode Pest in the Sugar Beet.

The nematodes or round worms constitute one of the most widely spread class of plant pests, and are even more serious in their attacks on animals, including man. Various parts of plants may be attacked, from the root to the fruit; but the present note will only refer to the first named organs, and thus deal with certain forms which spend part of their life in the soil. Probably the most widely distributed of these root nematodes, or eelworms as they are often called, is *Heterodera radicicola,* which has been found in all parts of the world. It is a common pest in England, and has been described as infesting tea nurseries in India and Ceylon, as well as Cinchona plantations (for quinine production in the former country); and has probably been observed in many other crops in the tropics : the coffee plantations in Brazil are reported to be commonly attacked by eelworms in their roots.

The life history is simple, and is chiefly remarkable for enormous powers of multiplication, within a short time under favourable conditions. And, from the extreme minuteness of the worms, their effect is usually not observed until any direct remedy is out of the question. Some details of the life history of this common form, obtained in the study of infected tea seedlings, may be given for the information of those who have not had occasion to give it attention. Starting with the egg, which is found inside the tissues of the plant root, the first sign of life is a minute worm coiled on itself while still inside the covering membrane. On the rupture of this cover, the worm escapes, and commences feeding on the plant juices. Being armed with a sharp, piercing stylet in front, it is able to move about; and sooner or later emerges from the root, where it meets numerous other individuals. After a while, it becomes lethargic and shrinks to an inert mass inside its skin : here it undergoes a moult, emerging in a considerably larger form. And now a distinction may be observed between the male and female worms. Although still of the same shape, the female approaches a root, enters it by means of its stylet, and soon becomes stationary. Feeding on the sap, it assumes a rounded form, and increases rapidly in size, so as to become visible to the naked eye. The result of this attack on the root, often by a considerable number of females at the same place, is that a gall is formed, either in the form of isolated nodules or in a general swelling of the whole root (as commonly in tea). The effect on the plant is serious, in that the nutrition obtained by the root is diverted to the egg formation of the parasite, this being the sole business of the swollen female : eggs to the number of hundreds gradually accumulate at the hinder part of the swollen bladder, and the female changes to a rounded mass of eggs. This life history is so rapidly gone through, that several generations may be produced during a single annual cropping season. A little consideration will show that it may be possible for a countless mass of eel-worms to be formed, in the vicinity of a single crop plant during its growth. Computations of this character have been made with many pests, till one wonders why this earth is not a solid, seething mass of beetles, locusts, fleas or eel-worms. Fortunately there are rules in nature against over production, but the point may be noted that, once the eel-worm has established itself, and the conditions are favourable, the only way to attack it is, somehow, to alter those conditions.

There are many kinds of eel-worms which attack cultivated plants—forty kinds have been described as attacking sugar cane roots in one country. Their classification is a matter of considerable difficulty; especially as the same species often acts differently under different climatic conditions, or when attacking different host plants. And this makes the study of remedial measures rather complicated. This is perhaps specially the case with another

species, named *Heterodera Schachtii*, which, among other crops attacked, has gained special publicity by being a serious pest on the sugar beet. This form passes through similar stages to those of the common form, with which the writer is most familiar; but there is one marked point of divergence. The female does not enter the root attacked, but merely plunges its head into it, and remains firmly attached and, living on the root sap, hangs its bag of eggs outside the root. Galls are not apparently formed, and instead of them the swollen female is what is to be looked for. Its comparatively large size makes it plainly visible, and an infected plant will be seen to have a number of tiny white or cream coloured dots attached to the rootlets, as shown in the accompanying figure. This then is the first visible sign of an invasion of the sugar beet nematode, which sooner or later leads, of course, to a diminished yield and, later, to small and miserable looking plants or even bare spots.

Nematode-Infested Sugar Beet.
(Two-thirds Size).

The pest in question, *Heterodera Schachtii*, has been known for a long time in the continental beet fields, and has been most exhaustively studied there; the importance of the problems raised being gauged by the fact that whole experiment stations have been founded for the sole study of the best means of fighting it. According to a bulletin just received from the United States Agricultural Department,[1] the pest has been known in the sugar beet fields there for the past 20 years; and at the present moment is found in practically the whole of the beet tract, which lies in the dry western part of the country. The attacks are chiefly concentrated in the States of Utah and California, with outliers from the former, to the north, in Idaho and Montana, and to the east in Colorado (noted in 175 fields) and Nebraska. It is also reported to be present in England on potatoes; but whether it occurs on the beet or not appears to be somewhat in doubt. The matter is, we are told, under special investigation. This is as well, for here we meet with a case where a species of nematode behaves differently under different conditions, since it apparently does not attack potatoes in the United States.

A great number of remedies have been tested, from time to time, experimentally; but it will be obvious, from the short sketch of the life history of the parasite given above, that in any infestation which is serious enough to draw attention in the field, the number of eel-worms present on the roots

[1] Control of Sugar-Beet Nematode by Crop Rotation. G. THORNE. *Farmers' Bulletin*, No. 1514, November, 1926.

and in the soil must already be enormous : so numerous, indeed, that direct methods of destruction will be comparatively useless. The problem is more likely to be solved along the indirect line of making the conditions unsuitable for the growth and multiplication of the parasite. This may be done in various ways, two of which will be mentioned here. The female eel-worm, which is the form to be attacked, requires a great deal of sap for the production of its eggs ; and all the other stages thus far mentioned are quickly killed by drought. In those places where one part of the year is habitually dry, the thorough drying out of the soil is not a matter of great difficulty. But this requires a continental climate, and is therefore not likely to be of much use in this country. And furthermore, the parasite appears to have guarded itself against this eventuality, in that the females are able to adapt themselves to dry conditions by going into a resting stage in an encysted and drought-proof form, which has been noted as lasting for several years without injury. This resting condition ceases as soon as moisture is again available, and the normal production of eggs is at once resumed.

The other method is more drastic, and simply consists in ceasing to grow the sugar beet on the land for a number of years, and thus depriving the parasite of food : obviously the period of resting the ground from beet must take cognizance of the length of the resting stage, and of the susceptibility of both weeds and other cultivated crops by which the beet is replaced. The idea, of growing crops of weeds greatly appreciated by the eelworm, and reaping the crop when most fully infested and destroying it, is a very tempting one. This has been tried, and it is claimed successfully ; but it needs a considerable amount of knowledge and the exercise of very great care, or the experiment may turn out to be a two-edged weapon, and do more harm than good. All the same, a thorough knowledge of what weeds are liked by the parasite and what are not, should be acquired as early as possible by the farmer for his own protection. This throws one back upon crop rotation as the main line of defence ; and it has this advantage, that, by instituting a carefully thought out system of using only plants disliked by the eelworm, the danger of commencing infestation is once for all disposed of.

It is pointed out that, in the United States sugar belt, it is only those fields which have been planted continuously with sugar beet for a long period that become seriously infected. Such fields are those nearest to the factory, for it is obvious that the use of such fields would greatly reduce the heavy transport charges, a point of view well appreciated by cane growers. Rotation of crops is thus imperative, not only for the reduction of the numbers of eelworms, but for the prevention of their ever attacking the beet. And the resting period mentioned above makes it necessary that the period of rotation should be a long one, if safety is to be ensured. This is the burden of the bulletin from which our picture has been copied. It summarizes the results of rotation experiments, in the United States sugar beet area, during the past seven years. The alternative crops recommended are peas, beans, potatoes, tomatoes ; while experience shows that wheat, barley and oats are less desirable although not susceptible to attack. Lucerne is considered especially good. If the infestation is moderate, this crop should be grown for three to four years as an alternative crop, after which it is claimed that beet can be grown regularly once every three years. Where the attack is severe, four to five years under lucerne are advised or, alternatively, one to two years under " small grains " (presumably those mentioned above) followed by two to three years of potatoes, peas, beans, etc. Those latter crops, which have proved to be unaffected in the United States, are said, however, to be

non-resistant in Europe. The many details, given in the tables, as to the crops of beet after the various permutations and combinations in the rotations, are therefore meaningless when applied to this country, and need not be gone into. The principle of rotation is, however, sound enough ; but the length of rotation required, and the crops grown in it, must be worked out afresh, if they have not been so done already. As in almost all other crops, one cannot transport the work done in one country bodily into another, without an independent series of confirmatory experiments under the local conditions.

C.A.B.

The Canadian Sugar Industry.

By E. L. CHICANOT.

The Canadian sugar industry, which has developed into a major Dominion activity, is in certain respects a peculiar one. Most Canadian industries established have regard to the exploitation of Canadian raw resources and develop through their expanding utilization. The sugar industry, on the contrary, has reached its present eminent position through the almost exclusive use of imported raw material. Canada is one of the heaviest consumers of sugar among the nations of the world, but has not been producing the basic commodities of manufacture. Instead of purchasing the finished product, however, the Dominion from an early date imported raw material under extremely favourable circumstances, and with this has developed a thriving refining industry. Then, having expanded to fully meet domestic requirements, the Dominion went abroad and successfully penetrated foreign markets with her product, building up a voluminous and remunerative trade with a number of countries.

Sugar being a staple product and a necessity of every day life which Canada could not provide, entry has been facilitated as far as possible, and the history of the industry in Canada discloses it signally free from serious tariff agitations. Claims were readily recognized and tariff regulations have favoured the steady development of the industry. It has been possible to import raw sugar for refining under the general tariff at 50 cents below the rate for imported sugar. The standard grade of raw sugar imported from Cuba for sale pays $1·79 per cwt., but if for refining $1·29 per cwt. If imported under the British preferential tariff for refining, however, only 29 cents per cwt. is charged.

Having to look to an imported product for manufacture, Canadian sugar refineries came naturally to be located at or near seaports. The first refinery was located at Montreal shortly after Confederation. A decade or so later the industry came to be established in the maritime provinces, and about 10 years after that on the Pacific coast. Various changes in the way of consolidations and amalgamations have taken place in the ensuing years though the centres of the sugar industry have remained unchanged. At the present time there are in Quebec two plants, both situated in Montreal ; in Nova Scotia there is a refinery at Dartmouth ; in New Brunswick there is a plant at St. John ; and in British Columbia one at Vancouver.

The industry melted imported cane sugar entirely up to about 1882, when the first beet sugar was imported from the European continent. After this, beet came in regularly, in varying volume, depending upon the supply, comparative prices, and other trade factors up to the time of the outbreak of the war. The trade brought to an end with the outbreak of hostilities has never since been resumed and for many reasons it is not

expected there will ever be any further introduction of foreign beet sugar for refining. Such imported raw material as enters into Canadian sugar manufacture at the present time is all from cane.

At a later period the sugar beet growing industry was inaugurated in Ontario and plants established at Chatham and Wallaceburg where the industry has thrived. Sugar manufactured from home-grown beets has, however, gone but a very small way towards meeting domestic requirements. Not more than 10 per cent. of the sugar consumed in Canada is manufactured from home-grown material. In 1925 a beet sugar industry which had been launched in Southern Alberta before the war and expired after a few years was revived with the establishment of a plant and surrounding industry at Raymond, near Lethbridge. This brought the number of refineries in Canada to eight at the end of that year.

The capital invested in these refineries was $50,089,717, having steadily increased to this figure from $35,783,067 in 1921. A total of 2784 individuals found employment in the industry and were paid $3,828,442. The materials used in the industry had a value of $54,457,385 and the gross value of production was $68,445,879. The net value added by manufacture was $13,988,494. In the year 1924 when the capital investment was $5,000,000 less, the sugar industry was listed as standing ninth among the Dominion's industrial activities.

To meet the growing domestic need, and then ambitiously to seek markets abroad for the surplus, the production of sugar in Canada has steadily risen until in 1925 585,748 short tons were manufactured valued at $66,983,488. Granulated sugar made from cane totalled 485,000 short tons and that from beets 36,410 tons, the two having a total value of $60,093,130. Soft sugars made from cane amounted to 64,334 tons, valued at $6,890,358. In the manufacture of this sugar 582,655 tons of raw cane sugar were used, valued at $47,025,265 and 370,047 tons of sugar beets with a value of $2,688,302. The cane sugar was, of necessity, all imported, while the beets constituted the entire Canadian crop of that year. Of all the imports for manufacture, nearly one-third of the volume of raw materials comes from Cuba, more than one-fifth from the British West Indies, and about one-sixth from San Domingo. Something less than one-half of the total comes from countries of the British Empire.

The development of an export trade in sugar has been one of the outstanding features of Dominion external business in the post-war period. In 1910 43 tons of sugar were exported from Canada with a value of $6213 ; in 1912 145 tons, worth $9580 ; and in 1914 1½ tons, worth $126. The export of sugar from Canada is necessarily periodically affected by many international trade factors and subject to frequent fluctuations. In 1918 exports had risen to 68,472 tons, worth $8,976,686 ; and the pinnacle of wartime trade was reached in 1920 when 122,661 tons, valued at $22,479,409, left the country. The industry slumped in the general depression which followed and has been slowly recovering ever since. In the twelve months ended September, 1926, the export of refined sugar from Canada amounted to 2,717,339 cwts. worth $16,018,235, a greater volume though the price has declined. Taking the figures of the first six months of the present fiscal year, the heaviest importer of the Canadian product is the United Kingdom, which accounted for approximately half the total exports, though slumping to this proportion from about 80 per cent. of the total in the previous corresponding half year. The next heaviest purchaser is Uruguay, followed by Norway, France, Newfoundland, British India, and the United States. In all, Canadian refined sugar is going to a great variety of countries.

As the only raw material used in the Canadian industry comes from the sugar beet districts, it is interesting to note the increasing acreage devoted to this crop and the swelling annual production, though the output is as yet insignificant in comparison with the imported cane for manufacture. In 1918 the Canadian beet acreage was 18,000 acres, producing 204,000 tons worth $2,593,715, from which 25,046 tons of refined beetroot sugar were manufactured worth $4 358,077. In 1921 25,535 acres were grown producing 199,334 tons of beets worth $1,974,384, from which 26,431 tons of refined sugar worth $3,554,203 were manufactured. In 1925 from 34,803 acres grown, 370,047 tons of beets were produced, valued at $2,688,302, and from these 36,410 tons of refined sugar, worth $5,206,624, were manufactured.

The 1925 statistics include the acreage and production of the new beet sugar industry which was inaugurated in Southern Alberta in that year, and the significant phase of the sugar industry in Canada at the present time would seem to be the increasing attention being paid to the possibilities of beet raising in the western provinces, which has for its object the ultimate furnishing of Prairie Province requirements. Any extension of refining from this source in Western Canada can be effected with little result to the industry, which is at present furnishing domestic requirements, while it may tend to limit raw importations.

The existing sugar refineries are situated at either end of the Dominion, and sugar as far west as Regina is shipped from Montreal, while from Regina west the territory is largely served by Vancouver. The sugar importation of the prairie Provinces, their third largest item, costs approximately $10,000,000 a year To adequately meet this demand locally from six to eight factories such as that recently established in Southern Alberta would be required, and the cultivation of from 60,000 to 75 000 acres of land to furnish the necessary raw material. It has been estimated that agricultural and manufacturing industries would occupy the labour of 5000 farmers, 8000 hand labourers, 2000 factory workers, and would use each year 125,000 tons of coal, 1,500,000 sugar bags, 30,000 tons of lime rock, 3000 tons of coke, 200 tons of soda ash, with numerous requirements of other supplies much of which could be found in the region.

The second season of the revived sugar beet industry in Southern Alberta has been concluded in a manner most favourable to the future expansion of the industry over Western Canada. The $1,500,000 enterprise at Raymond paid out in its brief 1926 operating season $200,000—$150,000 for beets $20,000 for labour at the factory, and $30,000 for materials such as coal and lime. Beet deliveries at the plant, from the 6000 acres under cultivation, ran to 35,600 tons, and from this approximately 10,000,000 bags of sugar were manufactured, while 12,000 tons of pulp were made available. Alberta sugar has now been on the market for two years, with not a single complaint received, and icing sugar is shortly to become a manufacture.

As far as the farmers are concerned, complete satisfaction has followed the establishment of the industry which in every stage has been expertly supervised and advised. Yields have been excellent in Southern Alberta, and whereas 10 tons per acre is considered a fair average, many fields in the area have yielded from 12 to 20 tons. As a result of this and of improving sugar prices, the crop of 1926 proved a distinctly profitable one. A 50 cents per ton increase in the contract price was decided upon by the manufacturing company, raising this to $6·25 per ton.

On account of the excellent tests made in 1926 and also the better prices which have been prevailing for sugar, a new scale of payment has

been made for the coming season under which beet growers throughout Southern Alberta are to receive an increase of nearly 22 per cent., or $10 per acre, for their crops. A guaranteed price of $7·00 per ton will be paid for beets in 1927. Growers will at the same time participate in the usual bonuses and concessions provided in the terms of the old contract, and the increases that come from the sale of sugar at higher prices. Every assurance is given of a substantially increased acreage being devoted to sugar beets in Southern Alberta in 1927.

At the same time other phases of this domestic production of raw sugar are not to be disregarded. The experience of other beet-growing sections of the North-American continent is being duplicated in Southern Alberta, and the sugar industry is being reflected in livestock production. The beet by-products of the Raymond plant are being extensively used in lamb and steer feeding, and a thriving industry has been built up around the factory. At the same time the industry has been a significant factor in the absorption of new immigration, and in 1926 a large number of continental immigrants with certain experience in beet growing have been employed in Southern Alberta and given uniform satisfaction. Field labour is no small problem in the industry and the assurance of an equable flow of suitable workers is an important consideration in the matter of expansion.

The newly inaugurated beet industry in Southern Alberta is believed to be but a step in a gradual progress in which Western Canada will come increasingly to supply raw material for the sugar industry. The projected increase in acreage in Southern Alberta alone will mean the inability of the one factory to handle the supply of beets, and with this possibility in view it is understood that two possible sites for an additional factory in the area have been tentatively selected. There are thousands of acres of similar irrigable land in Southern Alberta suited to the growing of sugar beets, and it is difficult to foresee the limits of expansion there.

From all indications, too, it will not be long before Manitoba has a beet sugar industry. The province has for some time been making tests in various parts of the province, through the distribution of seed to farmers and a supervised production by an experienced beet sugar man. Results have on the whole been eminently satisfactory and the beets found suitable for factory purposes. The province has been profiting by the proximity of the industry at Grand Forks, where conditions are very similar to those about Winnipeg, and studying both agricultural and industrial phases there. A substantial acreage is to be planted to beets in 1927 in Manitoba, and it is definitely announced that Winnipeg will have a refinery in 1927, in which American and Canadian capital are interested.

Establishment of a sugar beet industry in British Columbia will be undertaken if the provincial Government will subsidize the production of sugar, as to which a Vancouver syndicate has approached the provincial authorities. The proposal calls for a factory at New Westminster to cost about $1,250,000, capable of handling 1000 tons of beets per day. The subsidy asked of the Government would amount to half a cent. on all sugar produced up to 5000 tons. It is understood that the proposition is being given consideration.

This is the significant phase of the Canadian sugar industry as it affects the Dominion to-day. The era of beet sugar cultivation in Western Canada is just opening up. This vigorous Dominion industry has been founded and developed upon an imported raw product. The tendency would now appear to be increase the supply of a domestic product for manufacture.

The British Refiners' Case from a West Indian Point of View.

By FRANCIS WATTS, K.C.M.G., D.Sc.

The British refiners have recently put forward a statement setting out various grievances relating to matters which they claim are adversely affecting their interests and seriously damaging their business prospects. These matters are of considerable importance to British West Indian sugar producers, for many of the grievances referred to affect the interests of these producers equally with those of the refiners : moreover, it will be well to watch the discussion carefully lest any suggested remedies may react prejudicially with regard to West Indian interests.

The refiners claim that for many generations there has existed in the United Kingdom an important refining industry which is an integral and essential part of the business of sugar production : this industry at the present time employs about 10,000 men, turning out some 900,000 tons of refined sugar out of the total 1,710,000 tons, including direct consumption, raw sugar, and imported refined sugar, required for the consumption of the United Kingdom. They point out that this refining industry is threatened in several ways and that measures of relief are called for.

A particular grievance of theirs is that the production of beet sugar in the United Kingdom has been encouraged in a manner particularly inimical to the refiners' interests ; that Government subsidies contributed from the pockets of the British tax-payer amount to 26s. 10½d. per cwt. (£26 17s. 6d. per ton), made up as follows :—a subsidy of 19s. 6d. per cwt., plus 3s. 1½d. on molasses, plus 4s. 3d. per cwt. preference or protection. It is observed that these subsidies and preferences amount to something like 150 per cent. on the bonded value of the sugar, which, at the time the statement was issued, was put down as 27s. or 27s. 3d. per cwt.

As the outcome of these Government subventions the quantity of Home-grown beet sugar is rapidly increasing : in 1925 it was approximately 50,000 tons ; it is estimated that it will probably reach 130,000 tons in 1926 and is likely to increase greatly in the near future. As the whole, or by far the greater part of this sugar, is refined sugar it competes directly with the sugar produced by the refiners, causing them great anxiety, their market being invaded by State-subsidized sugar against which it is hopeless to compete.

It may at once be pointed out that this subsidized British beet sugar affects the Dominion and Colonial producer exactly as it affects the refiner ; it tends to crowd Dominion and Colonial sugars out of the United Kingdom.

The refiners urge that their interests would not have been prejudiced if the subsidies and preferences granted to British-grown beet sugar had been confined to raw sugar, as that sugar would have to pass through the refineries ; it would merely have created another source of supply. This is true so far as the refiner is concerned, but the Dominion and Colonial producers would be prejudicially affected by these heavy subventions even when applying to raw sugar only.

The refiners criticise the administration of the funds provided for these subsidies in that "the Government took only the advice of interested foreigners and engineering firms in the United Kingdom with little knowledge of the subject, the net result being to bolster up an industry hopeless on its merits and at the expense of the refining interests." They might have added: And at the expense of the Dominion and Colonial producers.

During the latter part of the nineteenth century a gigantic system of direct and indirect bounties existed in Europe which was only brought to

an end by the Brussels Convention in 1903. The effect of these bounties was to cause the influx of an enormous quantity of bounty-fed beet sugar into the United Kingdom to the total exclusion of British Colonial sugar, the Colonial interest being saved from extinction only by the fact that the United States' markets were then open to them, owing to the imposition there of countervailing duties and the absence at that time of any extensive competition on the part of American sugar; the latter nevertheless soon became of such importance as to lead to American tariffs discriminating adversely against British Colonial sugars and causing the American market to become completely closed to these sugars. Fortunately, however, the Canadian market became available about this time to British Colonial sugars by the imposition of coutervailing duties, which have remained in force since then.

Under the stimulus of the bounties the importation of Continental beet sugar into the United Kingdom increased enormously; but while the total imports of beet greatly increased, to the almost complete exclusion of cane, the importation of refined beet sugar increased out of proportion, thus robbing the refiners of a large part of their legitimate trade (which in ordinary circumstances would have increased to immense proportions) but still leaving them an amount of business sufficiently large to maintain an industry of great size and importance.

Taking, for the sake of brevity, ten-yearly periods, the importation of raw and refined sugars into the United Kingdom and the percentage which the refined bears to the total sugar, we find as follows :—

Year	Raw	Refined.	Percentage of Refined on total.
1860	493,768	19,321	3·76
1870	716,800	95,200	12·00
1880	952,091	170,020	15·18
1890	880,178	558,694	38·82
1900	741,157	1,077,898	59·26
1910	986,776	945,454	48·94
1920	1,398,562	136,284	8·08
1925	1,514,330	862,340	36·03

* Tons of 2000 lb. From TRUMAN PALMER, *Concerning Sugar*

In the sixties of last century the total sugar imported was around 550,000 tons, only about 6 or 7 per cent. of which was refined, leaving the remainder, some 500,000 tons, to be dealt with by the refiners or consumed direct.

In 1903, when the Brussels Convention restricting bounties was about to come into force, the total quantity of sugar imported into the United Kingdom was 1,749,295 short tons, of which 1,040,969 tons, or 59·52 per cent., was refined sugar, and 708,326 tons, or 40·42 per cent. was raw. Thus, although the refiners had a larger quantity of raw sugar on which to draw, they had been ousted from the greatly extended market for refined sugar which in a normal way should have been theirs and their interests were thus prejudiced to a considerable extent.

The adjustments resulting from the Brussels Convention led to some reduction in the importation of refined beet sugar, the total amount of refined coming in in 1913 being 1,033,250 tons out of a total importation of 2,205,570 tons, or 46·85 per cent. Later on, the conditions resulting from the war led to a large reduction in the imports of Continental beet sugar, so that from 1915 to 1923 the amount of refined was only in the neighbourhood of 500,000 tons a year (or only about one-half of that of previous years) and only about 25 per cent of the total quantity of sugar imported. It looked as though the refiners were coming into their own.

Subsequent happenings have, however, dispelled these hopes. Reference has already been made to the unfair competition of home-grown subsidized beet sugar and the manner in which it is competing with home-refined. Another adverse factor is again assuming importance, namely the competition of subsidized Continental beet sugar, which, with the removal of the restrictions of the Brussels Convention, is again becoming formidable : this competition is aided by Customs duties and Cartels which, by regulating the price to be paid for sugar by consumers in the country of production and thus ensuring the producer a substantial profit, permit of the sale of the surplus production in the United Kingdom at low prices against which British producers are unable to compete. While some of the sugar thus dumped in England is raw sugar, a considerable and increasing proportion is refined. Thus both the Colonial producer and the British refiner are ousted from what they feel is their legitimate market ; they are unable to compete against these fiscal disabilities and urge that their position should have consideration.

The pressure arising from the competition under these conditions of Czecho-Slovakian sugar is instanced ; it is pointed out that the importation of refined sugar from Czecho-Slovakia into the United Kingdom has risen from 99,000 tons in 1921 to 240,000 tons in the first nine months of 1926 (at the rate of 320,000 tons for the year) ; it is estimated that Czecho-Slovakia under this system of subventions is already producing a million tons of sugar over and above the home requirements of that country ; it is evident that efforts will be made to force increasing quantities of this subsidized sugar upon British markets to the detriment of British producers. The case presented by Czecho-Slovakia is only one amongst the European sugar producing countries, in all of which, except Holland, sugar is protected by high import duties which permit of assistance to exported sugar by means of cartel subventions.

Probably the greatest menace to British sugar producing and refining interests arises from the increasing tendency to dump subsidized sugars, both raw and refined, on the markets of the United Kingdom. The situation is fraught with added danger to the British Colonial producer in that the refiners may be content to seek remedies against the introduction of refined subsidized sugar and may protest but little against the importation of subsidized raw sugar ; they may regard it as a useful source of supply.

But the refiners do not limit their objection to the importation of foreign refined sugar ; they go further and claim that they are placed at a disadvantage by the admission to the markets of the United Kingdom of refined sugar and sugar fit for direct consumption produced in the Dominions and Colonies. It is stated, for example, that Natal is turning out a large portion of its sugar as refined, or as white sugar fit for direct consumption, and, in order to enable this to be done, is importing sugar from Mozambique to replace it and enable the Natal grower to reap the advantage of the preference accorded to Empire sugar in the United Kingdom. This, the refiners complain, unduly increases the competition which they have to face. Again, it is represented that the Canadian refiners, owing to the slightly greater preference given in Canada to British Colonial sugars, are able to import that sugar, to refine it, and to place it on the English market to advantage, thus adding further to the competition to be faced by the British refiner.

In a general way the refiners complain that preferences, bounties, and cartels, in so far as they affect refined sugar, are encouraging the importation of this sugar to the United Kingdom to such an extent that the British refining industry is gravely threatened ; in evidence of which they point to

the existence of idle machinery and unemployment in the refineries, some of which are compelled to close down .

It would appear that dumping of subsidized sugars, whether raw or refined and whether British or Foreign, constitutes probably the greatest danger confronting the refiners and colonial producers. This is a matter which should have the most serious consideration ; it is one in which it should be possible for British refiners and producers to join hands for mutual support.

In seeking some remedy for these adverse conditions the refiners suggest two lines of action by which they may be afforded relief. The first is that the scale of duties on sugar imported into the United Kingdom should be altered so as to increase the duty on refined sugar by 1s. per cwt. (£1 a ton), and to reduce the duty on raw sugar by a similar amount ; the difference in duty between British and Foreign sugar still being maintained. The second suggestion is, that as all the refiners' competitors are stated to enjoy a subsidy in one form or another, the refiners in the United Kingdom should be granted a Government subsidy of 1s. 4d. per cwt. (£1 6s. 8d. per ton), on all the sugar they produce.

It will be well to consider these suggestions and to see particularly how they affect the Colonial producers' interests.

The claim put forward that the refiner occupies a definite and necessary place in the production of sugar for use in the United Kingdom and that the protection of his interests is to the advantage of the Colonial producer is deserving of consideration, and its truth may be admitted with some limitations.

While from earliest times the refiner has played an important part in preparing Colonial sugar for consumption, it must be remembered that he has not enjoyed a monopoly in this respect. From the inception of the industry Colonial producers have endeavoured to turn out some portion of their sugar in a state fit for direct consumption without the intervention of the refiner : it is well known that in the old days, when muscovado sugar was the only type produced, a considerable proportion was "clayed" or otherwise treated to render it as white as possible, while much well prepared brown sugar was specially made for direct consumption, so that the refiners had no monopoly and are not justified in claiming that they should be entirely protected from the competition of direct consumption sugars, the production of which has been within the province of Colonial producers from the earliest days of the sugar industry.

On the other hand, it may be freely admitted that the extinction of the refiner would be inimical to the interests of the Colonial producer who, while claiming justification for turning out at least part of his sugar in a form fit for direct consumption, must rely on the refiner for the means of disposing of the greater part of his raw sugar.

The case may perhaps be met by recognising that the production of *refined* sugar is specifically the business and function of the refiner and that he may reasonably claim protection with regard to this. This being so, it would appear possible to safeguard the refiner by giving increased protection to refined sugar as suggested in the first proposal made by the refiners.

This is the position frankly taken by the Canadian refiners who have been able to secure that, while preference is given to British raw sugars, the duty on refined shall be sufficiently high to protect refining interests. The Canadian refiners, however, go further than is deemed to be just to Colonial producers in that, by the intervention of a colour standard, the higher duty is levied

on sugar that is not strictly refined sugar and its production is thus denied to the Colonial producer.

On consideration it would seem that it would prove advantageous to British interests generally if a higher rate of duty were imposed on refined sugar entering the United Kingdom, in the manner indicated by the refiners, provided that unrefined sugars fit for direct consumption be not thereby excluded, and provided that steps be taken to prevent dumping of either raw or refined sugars from any country whatever.

It remains to be seen whether the definition of refined sugar as sugar polarizing 98° and over without any colour restriction would meet the case: it is open to suggestion that it would.

The quantity of refined sugar required for consumption over and above the direct consumption raw sugars will always be very considerable and will provide an adequate basis for the activities of the British refiners. It is remembered that unrefined sugar even when nearly white in colour is not suitable for the manufacture of many sugar products, such as jam, condensed milk and the like, nor will such sugar, as a rule, keep well; it does not therefore compete unrestrictedly with refined sugar.

Adjustment of the refiners' difficulties on the basis of their first proposal would appear to be preferable to adopting their second, namely that the Government should grant an allowance of 1s. 4d. per cwt. (£1 6s. 8d. per ton), on all refined sugar produced by the refiners. It is difficult to accept the contention that this allowance "would be a reduction of duty to the public and would, through competition, automatically be utilized to reduce the cost to the purchaser. and the refiner would find his remuneration in increased outturn and consequent decreased cost."

It appears difficult to suggest any remedy for the adverse conditions created for the refiner and to an equal extent for the Colonial producer by the competition arising from the disproportionately large subsidies now given to British beet sugar. From the general sugar point of view the position appears to be economically unsound, and inflicts the hardship of unfair competition on the refiner and on the Colonial producer. Presumably the claim is that the astoundingly large measure of financial assistance is designed to foster and encourage agricultural interests in the United Kingdom and that this is but a temporary measure. The position being as it is, there seems little that the refiners and Colonial producers can do beyond making clear to the public the extent and the unfairness of the competition thus created and to express the hope that these abnormal subventions may be limited as to the extent to which they may be developed, and as to the time over which they may extend. The situation affords further proof, if such were needed, of the truth that the British public have never thoroughly understood the problems of the sugar industry, nor do they appear to grasp the extent and importance of that industry and its place in the national economy. The sugar trade has exercised profound influence on Imperial development and will continue to do so for many years to come; it is most desirable, therefore, that commercial men and statesmen alike should have clear knowledge of the nature of sugar problems and their bearing on national affairs.

To cope with the outbreak of mosaic in South Africa, the Government has just issued a proclamation forbidding the planting in Natal and Zululand of any cane of a variety other than Uba without a written permit from the Ministry of Agriculture. And after the end of June next it will be illegal for any other cane variety to be kept in the fields. The Uba variety is defined as any sugar cane plant which has the characters of leaf and stalk of the cane recognized in Natal as Uba.

Some Remarks on the Kirton Beet Seed Trials.

By D. J. JANASZ.

It is very satisfactory that competitive trials with beet seed placed on the British market should be undertaken in Great Britain, in which country conditions influencing the beet crop are undoubtedly different from those of other Continental countries. In this connexion, however, the writer ventures to express the opinion that the trials made at Kirton,[1] interesting as they are in showing how the beet grown from different seed can vary as regards sugar content, yield per acre, and number of so-called "bolters," offer absolutely no criterion on which the merit of the competing seed can be judged. The writer of the article published, in describing the trials, is quite right in saying "too much reliance must not be placed on the figures as it is *now* certain that much more elaborate technique is necessary to ensure reliable results." This statement may be strengthened by saying that "no reliance" can be placed on the figures for the same reason.

The following are the essential conditions for trials carried out with beet seed to be of any economic value : (1) That the beet seed used should be taken from ordinary market seed and not from any specially selected "mother" stock. Every producer knows that the seed he sells is the second or third reproduction of his "mother" stock, and that the latter is naturally ever so much superior in its qualities to the ordinary market seed. It is therefore evident that the two cannot in fairness be matched against one another. (2) That the conditions of the soil as well as the time of sowing and reaping should as much as possible be identical for each competing seed.

It would appear that neither of these essential conditions was observed at the Kirton trials. But on the contrary that : (1) Some of the seed was taken out of stocks supplied in large quantities to sugar factories, other seed being sent by the producer direct for the trials. (2) The plots were 1/10th of an acre in area and 9 ft. wide, and they were not repeated. It may be suggested that if the whole of the trial field had been sown with one kind of seed only, there would be marked differences in quality and yield on each of the tenth-acre plots, possibly as great as those shown in the trials.

From a glance at the figures it appears that there is a more or less gradual increase in the sugar content from stock No. 1 upwards. This leads one to think that this increase might have had its origin in the position the different plots occupied on the land. This, of course, is only a suggestion as, not having seen the field on which the trials were made, it would be impossible for the writer to give an opinion on this subject. It may be hinted to the Director of the Kirton Institute that the surest way of arriving at a reliable result is to sow three rows of each seed right across the furrows and to repeat the plots about six times. Only the centre row of each plot should serve for the purpose of the trial.

It may be further be pointed out that the grower of seed who in many cases has spent his career in working at its improvement naturally wishes to safeguard his interests. To him the results of trials are a verdict on his life's work, and therefore it is only fair that he should be relieved of any possible doubt as to the fairness of the trial. This consideration makes one question the wisdom and fairness of publishing the results of trials until "the elaborate technique, which is necessary to ensure reliable results" has been acquired by those who conduct the trials.

It seems very much to the point to add here a description of how trials with sugar beet seed are carried out in Poland. These trials were commenced

[1] *I S J.*, 1927, 93.

many years before the War and carried out annually until its outbreak. They were resumed in 1922, and have been continued every year since that time. This description is extracted from the *Gazeta Cukrownicza* and gives an account of sugar beet seed trials made in 1922 by the Union of Sugar Factories of Poland :

> " With a view to renewing the experiments with sugar beet seed which had been carried out before the war, the Union of Sugar Factories formed a special Commission consisting of representatives of the sugar industry, seed growers, and experts to arrange competitive trials. These trials were carried out with great care by the sugar factories concerned. The object of the trials was to test the seeds supplied to the factories by various producers. Nineteen sugar factories, ten seed experimental stations and one farm in the neighbourhood of a sugar factory expressed their readiness to carry out the experiments. Out of a parcel of not less than 10,000 kgs. supplied to one of the sugar factories by the competing grower, one sack of seed was chosen for the trial. This sack had to bear the original marks and seals of the grower. On the 10th April Mr. M. LUBINSKI and Mr. Z. PRZYBEMBEL, Chairman and Secretary respectively of the Commission, personally distributed the sugar beet seed from that sack into small bags which were numbered and sealed. The particulars of the seed contained in each bag were written down and enclosed in a separate envelope with the corresponding number. The sealed envelopes were kept in a safe and only opened after the experiments had been carried out.
>
> The above two delegates of the Union of Sugar Factories, after they had verified the inscription and seals of the sacks which were supplied by eleven different producers, proceeded to divide the seed in these sacks into 30 bags containing 1 kg. of sugar beet seed in each. At the same time, samples of the different kinds of seed were packed in small paper bags containing 100 grms. each and sent to the seed testing stations in Warsaw, Posen Prague and Halle. Instructions were given as to how the experiments should be carried out, viz. : The plots on which the trials of the seed were made were to be very carefully selected. Each trial had to be repeated from six to eight times in three rows, of which only the middle row was to be taken into account for the purposes of the trial. These instructions were on the lines recommended by the well-known seed grower J. DAVIDSON, for which he was awarded a prize at a competition arranged by the Union of Sugar Factories before the war.
>
> The harvest of that year was a very successful one and the result of the competition was that by the 30th November, which was the appointed date, twenty-four reports of experiments were sent in. Three sugar factories wrote stating that their plots were damaged and three others did not send in any report. Before the final results were obtained a special meeting of the Commission was called at which they were informed that sacks numbered 4 and 8 contained the same seed (for the purpose of control). One can see that the experiments were carried out very carefully. As the different kinds of beetroot seed were repeated from six to eight times on each plot the results obtained, as far as the yield per hectare was concerned, were a comparison of 178 plots, and of 169 plots as regards polarization. Out of the 24 reports four were rejected on account of some inaccuracies in the fulfilment of the regulations. On the other hand, the remaining 20 reports which were the results of 137 plots as regards yield, and 133 with reference to the average percentage of sugar, were finally accepted."

In connexion with this matter, it would seem advisable in their own interests for the British sugar factories, as in Poland, to do their very utmost to obtain reliable knowledge on this subject by organizing extensive trials in each factory district directed by one central and impartial institution, doing this on thorough and serious lines somewhat as just described.

Further Investigations on the Beet Dehydration Process.[1]

By B. J. OWEN, M.A., D Sc, L F. MANÉS, F.C.I.P.A., A C G.I., and J. L. DOUGAN, C.B.E., M A.
Institute of Agricultural Engineering, Oxford.

Laboratory work, together with practical operation in the factory, has shown clearly that the drying of beet can be effectively controlled by using the principle discovered in the drying of vegetable matter, as evolved by the Institute. It has been found that the methods suggested by previous investigators for the dehydration of the beet (with perhaps the exception of Benjamin) were conducted upon wrong hypotheses, namely, the drying of the beet to exhaust most of the moisture for the complete coagulation of the albuminoids, and the rupture of the cellular walls. It has been found that there is no rupture of the cellular walls and that prolonged heat coagulation is not essential. Furthermore, there is no such action as lixiviation; the cellular walls are not ruptured, consequently there is only simple diffusion. These discoveries, which appear to be fundamental, have resulted in producing practical applications, either in the form of a process or apparatus. They may be grouped under the following heads :—(*a*) Drying; (*b*) Extraction; (*c*) Purification.

(*a*) Drying.

The desiccation of beet, previous to the extraction of sugar, had not, up to the time of the Institute's experiments, been effected on a practical scale with any substantial measure of success by the various methods described, not excepting the De Vecchis process. In that method the beets were cut into fragments, dried by progressive heating to about 100°C., kept at this temperature until the albuminoids were said to be completely coagulated, the walls of the cells cracked, and the cossettes sterilized, the cossettes so treated being afterwards lixiviated with hot water. It was discovered in the course of the present experiments that the initial drying of the fresh beets and the subsequent heating of the dried cossettes, as advocated in the De Vecchis process, were not necessary, and that the second stage of the process, to which the production of these results is ascribed is unnecessary.

The method introduced by the Institute consists in desiccating the cossettes by means of a drying agent, such as heated air, continuously and uniformly applied until the temperature of the cossettes is raised to about 93°C., and the moisture content reduced to approximately 5 per cent. of the weight of the material. This single desiccating operation causes the sugar-containing cells of the cossettes to be affected in such a way, and the albuminoids rendered insoluble to such an extent, that the sugar contained in the cossettes can be readily and effectively extracted. The resulting sugar juice possesses a higher degree of purity and concentration than raw juices obtained before the introduction of this method of drying.

The cossettes must be treated either in mass or in layers. The conditions under which the drying agent is applied are varied to suit the particular conditions under which the desiccating process is conducted. The principle

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[1] Abridged from a paper published in the *Journal of the Ministry of Agriculture*, 1927, **33**, No. 11, 986-996, entitled "Some Discoveries in the Treatment of Sugar Beet" Article reproduced by permission of H. M. Stationery Office and the Ministry of Agriculture and Fisheries; and illustrations with the sanction of the Institute of Agricultural Engineering, Oxford. See also *I S.J.*, 1925, 158; 1926, 110, 118, 122, 542.

underlying this method of treatment is based upon that which governs the drying of agricultural crops, which has been fully described in the report[1] on this subject published by the Institute. Some of the methods[2] to which the principle, as adopted for the drying of sugar beet, has been used by the Institute, are given. Figs. 1, 2, and 3 show some of the methods of drying employed by the Institute.

Continuous Mass Drying (*Fig.* 1).—The diagram illustrates a type of conveyor dryer. Dr. DE VECCHIS used a dryer having five conveyor belts for two-stage drying. The second stage was for the purpose of coagulating the albuminoids. The dryer, as shown in the accompanying diagram, consists of three belts placed one above the other and enclosed in a suitable casing. A chain drive on the outside of the casing actuates the belts, which travel at different speeds. The freshly sliced beet is fed at the top of the dryer through a hopper (*a*) and falls in a mass directly on to the end of the top belt (*b*),

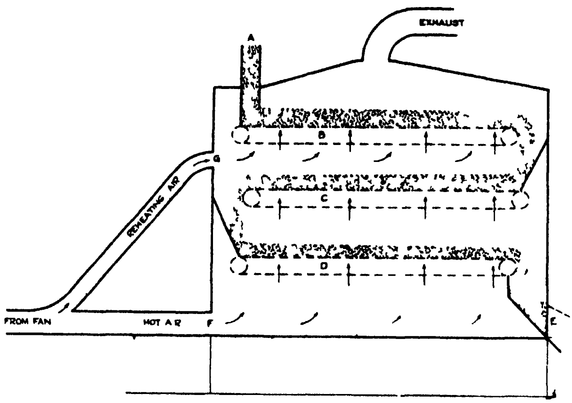


FIG 1 —Continuous Mass Drying

which carries it along to the further end. Here it falls on to the second belt (*c*) which carries it back through the length of the dryer until it falls on to the bottom belt (*d*). The bottom belt carries it along to a discharge (*e*) at the opposite end of the dryer. Hot air is introduced at the lower portion of the dryer as shown at (*f*), and passes through the layers of beet on the bottom two belts (*d*) and (*c*). A supply of reheating air is introduced between the two top belts as shown at (*g*). This supply of reheating air is for the purpose of raising the temperature of the first supply which has been reduced by its passage through the mass of the beet. The air, after passing through the top layer of beet, is exhausted to the atmosphere, completely saturated. The dryer is provided with suitable air-locks at the ends of the belts to prevent the short-circuiting of the air.

Stack Drying (*Fig.* 2).—The diagram shows the method adopted for the drying of cossettes in a stack. A cage of wire mesh was constructed on a platform (*a*) in the form of an annular ring; the central portion of the ring was provided with a circular damper (*b*) fitted on to a vertical screw (*c*). An air duct (*d*) was provided, which delivered the hot air to the centre of the cage as shown. The cage was filled with beet, through which hot air was

[1] *Preliminary Report of the Investigation into Artificial Drying of Crops in the Stack.* Institute of Agricultural Engineering, University of Oxford Published by the Clarendon Press

[2] The patents governing the process are the property of a private company registered as Sugar Beet and Crop Dryers, Ltd

then blown from the inside of the cage to the outside. As the beet contracted while drying, the circular damper was lowered by means of the screw.

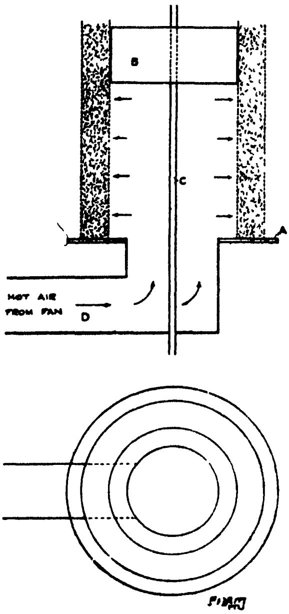


FIG. 2.
Mass Drying in Stack.

Mass Tray Dryer (*Fig.* 3).—This type of dryer consists essentially of a low staging on which are placed a number of trays. The space underneath the staging is divided into a number of compartments as indicated by the cross section. The object of this is to control the temperature of the air passing up through the beet so that the air at the highest temperature passes through the wettest beet. The staging is arranged on a slight incline to facilitate the easy movement of the massed beet, which has a depth of from six to eighteen inches. Rollers are also provided to enable the trays to move along the staging with greater ease. The number of trays is two more than the number of heating compartments ; one of these is being filled with fresh beet while the other is being emptied of dry. The trays are of wire mesh with a wood frame to allow of the free passage of the heated air up through the beet.

In general when the sliced beets are treated in comparatively large or small masses, as in the conveyor, the stack or the tray apparatus, the desiccating operation is effected to the best advantage by controlling the consolidation of the mass of material, and promoting slight natural reactions, by supplying the drying agent to the mass at certain ranges of temperature, pressure, and volume which are

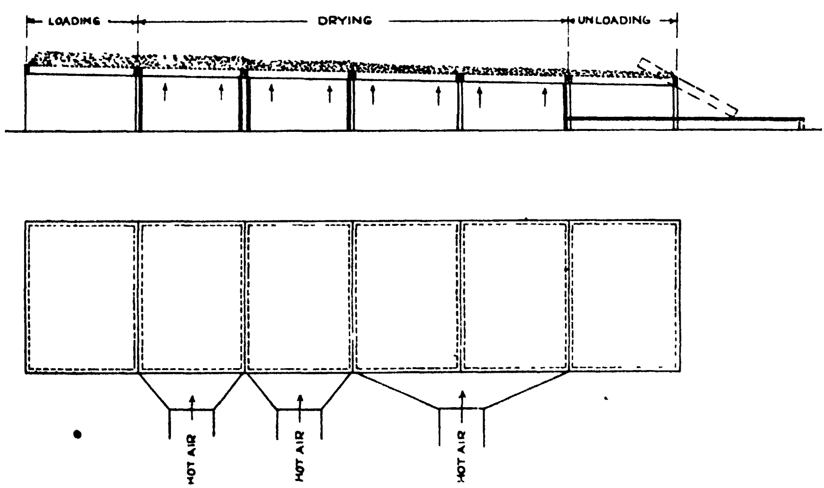


FIG. 3.—A Simple Tray Drying Device.

selected and co-ordinated, so that the rate of dehydration is increased to the greatest possible extent, and the effects of the smallest exothermic reaction are utilized to the best possible advantage.

In cases where the cossettes are desiccated in masses of relatively small thicknesses or in layers or beds, the treatment is equally successful. The conditions as to temperature, pressure, and volume under which the drying agent is passed through the material, the thickness of material, and the time which it is subjected to the drying agent, are determined and proportioned so that the material is dehydrated as advantageously and economically as possible, and is not heated to a dangerous or injurious temperature during the process.

By means of the treatment the cossettes are reduced to a suitable condition for successful extraction without the danger of undue caramelization of the sucrose in the beet, or undue conversion of that substance into invert sugar. Moreover, the cossettes can be treated without the provision of elaborate and expensive drying plants, and the desiccating operation can be carried out satisfactorily in the field as well as in factories, with the further advantage, in the former case, that the cossettes can be transported after treatment at a considerably lower cost as compared with the cartage of heavy fresh beets.

(*b*) Extraction.

An extracting or diffusing apparatus was designed, having for its object the provision of means whereby the process of exhausting the cossettes and obtaining the sugar in the form of a syrup can be carried out in a continuous operation and in an effective and expeditious manner. This apparatus consists of a vertical extraction vessel to which the material is fed continuously and impelled upwards and exhausted by means of a counter-current of water, which is caused to gravitate continuously through the ascending material. Means are also provided for straining and collecting the resulting liquor or syrup and for draining and discharging the exhausted material from the extractor, and for enabling the extraction to be conducted at a suitable temperature.

The accompanying illustration (Fig. 4) shows the apparatus in sectional elevation :—(*a*) is the vertical cylindrical extraction tube (shown broken off as to its major central portion), which is provided towards the base with a suitable aperture or cut-away portion (a^1), by way of which the material is continuously fed from an inclined chute (*b*) into the tube. The material so fed is delivered on to a revolving helical worm (*c*), which substantially fills the interior of the extraction tube (*a*) and causes the material to ascend continuously along the spiral path formed by the helical worm. The internal helical worm (*c*) is furnished with an actuating shaft (*d*), which passes through the centre of the apparatus and is driven from any suitable power.

The upper portion (d^1) of the central shaft (*d*) is hollow, and extends beyond the extraction tube (*a*) and the helical worm (*c*) to the uppermost part of the apparatus, the hollow portion (d^1) being connected at the upper end by a pipe (*e*) to the source of supply, as for instance a constant level tank (not shown), which supplies the exhausting water. The hollow portion (d^1) of the central shaft (*d*), by way of which the water or solvent is introduced into the apparatus, is provided on the lower part with a series of circumferential perforations (d^2) through which the water or other solvent passes into the extraction tube (*a*) so that the water is caused to gravitate continuously along the spiral course of the helical worm (*c*), and to mix effectively with the material ascending within the extraction tube. The extraction tube (*a*) is surrounded by an outer annular jacket (*f*), which extends from the aperture portion (a^1) of the tube to the level of the perforations (d^2) in the hollow portion (d^1) of the central shaft (*d*), so that the major portion of the extraction tube (*a*), within which the exhausting operation actually takes place, may be brought to, and maintained at, the temperature at which the material can be treated to the best advantage. The annular jacket (*f*) may be supplied with steam or any other suitable heating medium,

according to the particular requirements, and is provided for the purpose with an upper inlet pipe (f^1) and a lower drain pipe (f^2).

The extraction tube (a) is formed above the annular jacket (f) with an upper extension (a^2) which encloses the lower part of the hollow portion (d^1) of the central shaft (d), and the upper part of the helical worm (c), and which is circumferentially perforated to enable the exhausted material to be drained of its excess moisture before being discharged. The water so drained is collected by an external gutter (g), provided on the perforated extension (a^2) of the extraction tube (a), and may be returned to the source of supply for further utilization within the tube. The extraction tube (a) terminates at the uppermost portion in a slanting chute (b^1), by which the exhausted material is discharged. The extraction tube (a) is mounted in a tank or vat (h), which is placed at the lower part of the apparatus. Its height is such that the upper level is sufficiently low to permit of the observation and regulation of the material fed into the apparatus. The lower part of the extraction tube (a) is circumferentially perforated as shown (a^3) to allow the liquor to drain into the tank. The upper part of the tank has an annular strainer (h^1), through which the collected liquid passes and flows into an external gutter, whence the strained liquid passes out of the apparatus through a pipe (k^1). The collecting tank is supported on a platform (m) so that the central shaft (d) can be extended below to permit of its being conveniently mounted and driven. Thus the lower portion of the central shaft (d) can be passed

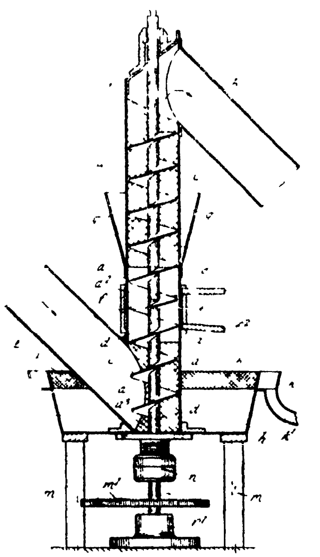


FIG 4
Continuous Diffusion Extractor.

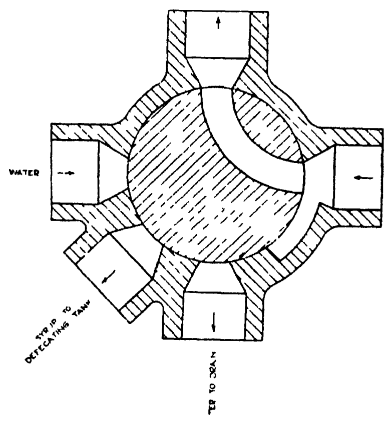


FIG 5.
Multiple Way Cock.

through a stuffing box (n) and provided with driving gear (m^1) and can be mounted in a lowermost thrust-bearing (n^1). This method supersedes those formerly employed in extracting the sugar by lixiviation.

A multiple-way cock was invented for the regulation and diversion of the flow of different liquids in connexion with the diffusion vessels ; but it can be used for all forms of work necessitating the distribution and regulation of liquids of varying densities. Its construction is shown in Fig. 5.

(c) PURIFICATION.

The Institute has elaborated a process for purifying or defecating sugar juice or syrups. Its object is to simplify and expedite the treatment of the raw juices obtained, and to produce a final liquor which is more highly puri-

fied and more readily crystallizable than that obtained by former processes. It consists, first of all, in acidifying the crude syrup and subsequently rendering the acidified syrup alkaline to such a degree that the colloids and other impurities which interfere with crystallization are precipitated, and that the final liquor when filtered can be crystallized without further treatment.

In putting the process into practice the raw juice is first treated with a quantity of calcium superphosphate. The acidified syrup so obtained, after being warmed to a temperature of about 80°C., is then treated with a quantity of slaked or unslaked lime, which so exceeds that required to neutralize the acidity produced by the first treatment that the syrup is rendered adequately alkaline to effect the precipitation of the impurities. The excess of alkalinity of the syrup may, if required, be afterwards adjusted by the addition of further calcium or lime superphosphate so as to bring the final liquor to a suitable condition for boiling in vacuo and crystallization.

By means of the process the decolorizing properties of the superphosphate, the acidity of which has no appreciable effect on the invert sugar content of the juices or syrup, can be utilized to the best advantage, with the result that the liquors produced possess a better colour and a greater brilliancy as compared with those hitherto obtained. A subsequent development has led to the employment of mechanical separation preceding the chemical treatment.

The process consists in clarifying the raw juices by mechanically separating the slimy and other undissolved or suspended matters from them and in defecating the juices so clarified by the addition of substantially dry tricalcium sucrate or dry calcium hydrate, the clarified juices being either first acidified and subsequently alkalified or first alkalified and then acidified, and finally brought, as required, to the requisite degree of alkalinity and filtered. In practice the raw juices are warmed to an appropriate temperature and clarified in a centrifugal separator. The clarified juices may, after further heating, be defecated by adding a proportionate quantity of calcium superphosphate or sulphurous acid, followed by a suitable quantity of substantially dry tricalcium sucrate or dry calcium hydrate. The alkalinity of the juices is finally adjusted by the addition of a further quantity of the superphosphate or acid. When the clarified juices are defecated in the reverse order, that is, when they are alkalified and then acidified, the acidity, if any, of the juices may be corrected by the addition of a further quantity of the tricalcium sucrate or calcium hydrate adapted to produce the requisite final degree of alkalinity.

The process, besides ensuring that the defecated juices can be readily filtered under comparatively low pressure, irrespective of their density or viscosity, further ensures, by the utilization of tricalcium sucrate or calcium hydrate, that, substantially, no water is added to the juices during defecation. Hence raw juices of relatively high density can be easily purified by the process and directly treated in single-effect graining vacuum pans, under conditions which do not necessitate any unduly prolonged boiling and which ensure a highly economical evaporation. Moreover, when tricalcic sucrate is used, the raw juices, besides being alkalified without the addition of water, are strengthened in their sugar content in proportion to the quantity of sucrate employed. These two methods of purification form a completely new process for the subsequent treatment of the diffusion juice, eliminating the difficulties found in the previous processes for the after treatment of the dried cossettes.

Leaf-Scald, a Bacterial Disease of the Sugar Cane.[1]

An extremely interesting paper on this new disease of the sugar cane, by D. S. NORTH, although bearing a date of over a year ago, has only recently been received. It is very comprehensive, and contains an account of work carried on by the author for quite a number of years : " it was prepared in draft form in 1923, dealing with investigations made chiefly at Broadwater Mill, Richmond River, New South Wales, between August, 1919 and December, 1922." The delay in publishing is, of course, regrettable, but the causes are adequately explained ; firstly, because of the necessity of studying certain Java papers (chiefly WILBRINK'S work on the Java gum disease and WOLZOGEN KUHR'S on *sereh*, and, secondly, by unavoidable crowding of other work. The paper itself gains considerably by this delay, however, for it has been thus possible to compare, very thoroughly the results obtained with those in Java, on this important class of cane diseases. The most significant fact which has emerged is that, after studying WILBRINK'S paper, the author concludes that leaf-scald agrees with the gum disease of Java " not only in essential factors, but in minor details in the majority of cases." There are of course some differences, and these are set out in tabular form. The absence of exact coincidence, dear to the heart of mycological experts, is explained by the fact that the canes affected were entirely different ones, the technique varied and, perhaps most important, the environmental surroundings which so greatly affect all plant growth could not have well been more dissimilar. For the rest, the author considers that, in certain important directions, WILBRINK has gone somewhat further than he himself, while his observations have added knowledge, on the dissemination of the disease, which render the Java author's suggested control measures inadequate.

The bulletin is 80 pages long and is beautifully illustrated. As it is in many places highly technical, its value to the general reader is enhanced by the use of a smaller type for the details of bacteriological and other experimental work. It will, unfortunately, not be possible here to do more than pick out some of the points of more general interest. Leaf-scald is a destructive disease of the vascular system of the sugar cane in Australia and Fiji, and its attacks closely resemble those of COBB'S gumming disease. These two diseases are, fortunately, often met with together in the fields, and have thus been studied, side by side, right through the investigation. The causative bacteria of the two diseases differ in size and behaviour in cultures ; and in both the readiest field symptom is a streaking of the leaves, but the markings are easily distinguished. Those of leaf-scald are present in the young leaf, while in gumming they rarely appear until the leaves are full-grown. In the former, the streaks are at first narrow, well defined and very straight, creamy or greyish white, and they often extend right through leaf sheath and lamina. In gumming, they are yellowish, broader and with an irregular outline, and are usually much shorter. Further, when a stalk is cut, gum exudes from the surface in gumming, while this is not the case with leaf-scald, the ends presenting a peculiar dry appearance.

This disease appears to be somewhat closely entangled with a fine cane called Mahona, which was introduced from New Guinea in 1896 : a cane which showed exceptionally fine quality, was quick in growth and yielded heavy crops, but appeared to mature too early and then died off. The author, however, when he saw it in 1908, formed the opinion that the last named character, because of its irregularity, was probably caused by disease. Leaf-scald was not, however, definitely recorded until 1911, when it was observed,

[1] Leaf-scald, a Bacterial Disease of Sugar Cane. D. S. NORTH. Agricultural Report No. 8 (*Technical*). Colonial Sugar Refining Company, Ltd., Sydney. January, 1926.

occurring spasmodically, in the cane fields in North Queensland. At present it is found in the same tract, and in New South Wales and Fiji ; in the latter case again appearing after it was thought to have died out.

One of the most important points regarding its symptoms, which have in the past caused a good deal of uncertainty, is that leaf-scald occurs in two phases ; these having previously been considered to be different diseases. There is an *acute* form and a *chronic*. In the former, affected plants suddenly wilt and die, looking exactly as if they had been pulled up, and thus deprived of their water supply. The leaves wither, and then the stalks gradually shrink and dry up : on occasion, whole fields are suddenly attacked in this manner, although, more frequently, individual stools or even parts of stools are affected, contrasting strongly with the general green colour of the plants around them. This wilting can be extremely rapid in dry weather. Affected stools may show no obvious symptoms, whereby they can be distinguished from a bad attack of white grub ; but careful examination at the base will not infrequently reveal tiny shoots, either springing from the ground or the side of the stalk, which exhibit the characteristic leaf markings of the chronic phase.

Plants attacked by the chronic form show the leaf markings already described : straight, narrow, well defined streaks, ranging from one-eighth of an inch in width down to a barely perceptible mark, often extending throughout the entire length of leaf sheath and lamina, or running out on the margin towards the leaf tip. These are very well shown on a coloured Plate. The streaks tend to broaden and become more diffused in older leaves, followed by a withering of the leaf tissues, especially in dry weather, and ending in a broad withered patch (from which, presumably, the disease has obtained its name.).

Another prominent feature in the chronic phase is a great development of side shoots and of small suckers, this tendency being even more pronounced than in gumming or Fiji disease, sometimes every bud starting in its growth both above and below ground. These shoots are exactly analogous to the shooting at the top of a cane, but present a miserable, attenuated appearance, usually dying when they have reached 6 to 18 inches in length. Their value in the diagnosis of the disease, however, lies chiefly in the fact that they often show the characteristic leaf markings, at a time when these are not so easily observable in the old dried up leaves of the stool at this stage of growth. Pronounced etiolation of the leaves also appears in advanced stages of the disease both in young and old plants. This somewhat obscures the streaks in the leaves, but they show up when the leaf withers, as they dry up first. Lastly, the leaves in affected shoots tend to curl upwards and inwards, giving, with the withered leaf tips, a highly characteristic appearance which at once arrests attention.

When a chronically diseased cane, not too severely affected, is split, the tissues are seen to be discoloured, sometimes along the entire length. This discoloration is caused by numbers of tiny red streaks in the fibro-vascular bundles, many of them exceedingly minute, and not nearly so broad as the bundles themselves. Most are to be seen in the nodes, but some may be found right through the internodes as well. The most important feature of these red streaks appears to be the close connexion between them and the shooting, or even swelling, buds. Reddening is rarely found in nodes where the buds have not sprouted. This character is thus not so often found in the acute phase of the disease : if no sprouting has commenced, the canes cut lengthwise do not differ in appearance from those of the healthy plants

around them ; but, where any small sprouts appear towards the base, these exhibit the red marks as usual. Such marks are also often found in leaves, although they may not be present, or may be there and yet not observable until the leaf is cut open. Both the ordinary streaks and the reddened ones show the presence of the invading bacteria. In advanced stages of the disease other tissues of the stem may also be invaded from the fibro-vascular bundles; in such cases red blotches make their appearance and, later, cavities may be formed. The roots have been dug up and carefully compared with those of healthy plants, but, excepting in the case of infected cuttings, their tissues have not shown anything characteristic of the disease. From what follows concerning the possibility of infection through the roots, it is felt by the author that this examination has not been thorough enough. This is all the more desirable in that WILBRINK has found that, in cases where the Java gumming is very severe, the whole root system becomes rotten and the plants may be easily pulled up.

As to the effect of leaf-scald upon the cane crop, the author cites experience gained with Mahona, the cane variety which has been practically wiped out by the disease. At Richmond in New South Wales, where most of the observations were made, 7700 tons of cane were destroyed on 1500 acres, during the years 1920-1923. A further source of loss is mentioned, in the inadvisability of ratooning where the disease appears. Only highly susceptible varieties suffer such losses : moderately susceptible kinds, such as NG 24, suffer much less, while highly resistant canes, such as Badila, are only very rarely severely damaged. Thus far, no immune varieties have been met with, as occasional diseased stools have been found in all kinds continually exposed to infection. In a Table, the results are given, after prolonged observation in the cane fields at Richmond, as to the susceptibility of the varieties grown there during five years : Mahona, 7 R 96, and HQ 243 are classed as highly susceptible : susceptible 8 R 31 : moderately susceptible, 14 NG 146, NG 16, M 1900 Sdg., H 426 (Clark's Seedling), 7 R 428 (Pompey), NG 24, 24 A, 24 B (Gorru and its sports) : highly resistant, Badila, Malabar, D 1135, Innes 131, NG 14.

Leaf-scald may be spread through using infected cuttings, by the knives used in harvesting, and by some other means at present unknown. As to the last named, there appears to be a strong suspicion that the infection, which may leap over half a mile on to a different cane farm, is caused by some flying insect. The selection of healthy seed is, however, rendered especially difficult because infected cane is frequently of perfectly healthy appearance. Apparently the disease may remain dormant for long periods, ever ready, however to assert itself when its host shows signs of weakness. The whole subject of the control of cane diseases has been dealt with by NORTH in an interesting paper which was somewhat fully referred to in a former number of this Journal,[1] and further details concerning leaf-scald may be gathered here and there from that source. The author concludes this part of the subject in his summary as follows : " Control of the disease may readily be effected by the use of highly resistant varieties. Where it is desired to cultivate a susceptible variety, like Mahona, the most exacting precautions are needed to secure healthy plants, owing to the fact that many canes of healthy appearance harbour the disease in a latent condition. Any cane growing within a quarter of a mile or so of diseased cane, or that has been raised from seed cane from an " unsafe " source, must be regarded as " unsafe " for planting purposes. Also, all diseased crops should be ploughed out after harvesting, to get rid of sources of infection.

"Where a moderately resistant variety, like NG 16, is concerned, the application of such measures becomes a simple matter, owing to the slower rate of spreading of the disease in it. On the other hand, their application is seriously interfered with by the higher proportion of canes carrying the disease in a latent condition. Thus, resistant varieties are to be regarded as hidden carriers of the disease, and, as such, need special attention."

C. A. B.

Notes on Some British West Indian Sugar Crops of 1926.

By Sir FRANCIS WATTS, K.C.M.G., D.Sc.

(*Continued from page 77.*)

ANTIGUA.

Practically the whole of the sugar of this Presidency is made in two factories, the larger of which, Gunthorpe's, in 1926 turned out 10,522 tons of sugar, while the smaller, Bendal's, made 1780 tons.

During the past two seasons enquiry has been made to ascertain the relationship in this island between the rainfall and the crop of sugar cane, the data being obtained from a number of estates; for this purpose the rainfall for the 18 months of the growing season, namely from October to March, has been recorded and the quantity of cane produced per acre and per inch of rainfall calculated; in all cases the whole of the crop including plant and ratoon canes is taken into account.

In the crop reaped in 1925 it was found that the average yield of cane per acre was 15·7 tons, the yields ranging from 10·2 to 26·4 tons per acre on the 35 estates included in the observations. The quantity of cane produced for each inch of rainfall during the 18 months ranged from 0·16 to 0·42 tons; the rainfall during this period varied from 47·63 to 74·49 ins. on the individual estates. Eleven of the 35 estates produced 0·30 tons of cane and upwards per inch of rainfall, the highest being 0·42 tons. These 11 estates produced from 18 to 26·4 tons of cane per acre; no estate amongst the remaining 24 produced as high as 18 tons per acre, with the exception of one, which gave 20·3 tons; but it is to be observed that this last estate received the highest rainfall of the whole 35, namely 47·63 ins. in the 18 months, so that while it produced a relatively large tonnage it was not able to use the larger rainfall to full advantage.

Conditions were somewhat different with regard to the crop of 1926, when the rainfall for the 18 months ranged from 33·22 to 62·36 ins. and the average output of canes from all the estates was only 11·3 tons per acre; the smaller rainfall being reflected in the diminished return. Only four of the estates produced 0·30 tons of cane per acre per in. of rainfall, the highest being 0·46 tons. The four estates in question produced from 15 to 18·3 tons of canes per acre; only two of the other estates produced as much as 15 tons per acre and they received a relatively good proportion of rain, namely 53 and 54 ins. respectively.

These facts emphasize the point that the rainfall of Antigua is frequently too low for the production of large crops of cane and that this low rainfall is the principal limiting factor governing sugar production there; it has to be taken into account when considering the expenses which may be incurred in cultivating and manuring the canefields of this island.

[1] *I.S.J.*, 1924, pp. 522-528.

Notes on Some British West Indian Sugar Crops of 1926.

In view of the interest taken in the pioneer work done in Antigua with regard to factory developments, the nature of the cane handled at the principal factory there is frequently the subject of discussion when comparison is made with the work done in other places. In this connexion the following figures giving the average composition of the canes dealt with at Gunthorpe's factory may usefully be recorded :—

Year.	Sucrose.	Fibre.	Ratio Fibre-Sucrose.	Year	Sucrose	Fibre	Ratio Fibre-Sucrose.
1910	14·72	15·66	106·4	1919	12·30	16·67	135·5
1911	14·11	15·55	110·2	1920	13·03	16·90	129·7
1912	14·06	17·67	125·8	1921	13·02	17·73	136·3
1913	12·89	17·47	135·5	1922	12·06	18·63	154·5
1914	13·50	16·59	114·3	1923	13·34	16·48	123·6
1915	12·00*	16·90	140·0	1924	12·60	15·87	126·1
1916	12·53	16·24	129·7	1925	12·93	15·51	119·8
1917	12·97	17·43	134·3	1926	13·08	15·76	120·6
1918	13·10	16·05	122·5				

The canes dealt with at Antigua are characterized by a high percentage of fibre. This fact has some interest, for canes of this character were difficult to deal with in the 3-roller mills in vogue in the days of the muscovado industry and there is little doubt that it was this that led to the movement for improved machinery and central factories taking shape in Antigua earlier than in the islands in the neighbourhood. The cause of this high fibre content is, no doubt, the dry climate with frequent droughts experienced by this island.

The following salient figures relating to the work of Gunthorpe's factory for the crops of 1925 and 1926 will be interesting for comparison with the work of other factories :—

	1926.	1925
Tons cane per ton sugar	8·70	8·82
Cane—Sucrose per cent.	13·08	12·93
,, Fibre ,,	15·76	15·51
Bagasse—Sucrose per cent.	3·21	3·10
,, Fibre ,,	49·67	50·46
,, Moisture ,,	46·04	45·28
Sucrose in juice per 100 sucrose in cane	92·19	92·68
,, sugar ,, ,, juice	91·50	90·80
Commercial sugar per 100 sucrose in juice	95·33	94·65
,, ,, cane	87·84	87·66
Purity final molasses	34·17	32·32

The mills at this factory consist of four sets of 3-roller mills (30 in. × 60 in.), preceded by a Krajewski crusher; revolving cane knives prepare the cane for the Krajewski. Much benefit has been derived from the use of Messchaert grooves on the feed rolls of the mills, these being spaced at 2½ in. pitch. With this equipment it has been possible to grind, on an average, 33·38 tons of cane per hour during this season, a quantity of cane containing 5·26 tons of fibre.

During the season a portion of the scums was returned to the mills, but with the quality of cane and scum handled here, together with the equipment available, this was not as satisfactory as the corresponding work in this direction at St. Kitts. It is proposed to modify the defecators for the

* The low sucrose content of the canes of 1915 is attributed to the fact that 23·19 inches of rain fell during the reaping season.

coming crop, so as to produce a heavier scum which will be more readily handled.

During the year a discussion took place with reference to the alleged falling off in the sucrose content of the canes dealt with at Gunthorpe's factory. In this connexion the chemist to the factory took occasion to recalculate the figures relating to former years to ensure their uniformity. These returns show that there has been wide variation in this respect, but no simple explanation of this appears to be forthcoming. On the other hand, the figures show in an interesting manner the steady improvement that has taken place in the general work of this factory, as will be seen from the following extract from the returns put forward :—

	Cane,					
Year.	per cent Sucrose	per cent. Fibre	Bagasse, per cent. Sucrose.	Sucrose in Juice per 100 Sucrose in Cane.	Sucrose in Sugar per 100 Sucrose in Juice.	Tons Cane per ton Sugar.
1907	14·40	14·10	6·49	84·21	81·51	9·64
1908	14·31	15·24	6·19	85·41	85·92	9·17
1909	14·15	15·32	6·02	85·51	85·50	9·33
1910	14·72	15·66	6·14	85·47	85·65	8·95
1911	14·11	15·55	5·75	85·65	78·67	10·07
1912	14·06	17·67	4·99	85·88	83·55	9·52
1913	12·89	17·47	3·08	91·22	85·90	9·49
1914	13·50	16·59	3·60	90·57	87·28	9·07
1915	12·00	16·90	3·05	91·40	90·39	9·71
1916	12·53	16·24	3·01	92·22	91·60	9·07
1917	12·97	17·43	2·66	93·03	90·87	8·76
1918	13·10	15·05	2·45	93·85	89·05	8·78
1919	12·30	16·67	2·77	92·40	91·29	9·26
1920	13·03	16·90	3·09	91·89	91·03	8·81
1921	13·02	17·73	3·13	91·15	90·35	8·96
1922	12·06	18·63	3·37	89·54	89·63	9·93
1923	13·34	16·48	3·68	90·55	91·50	8·67
1924	12·60	15·87	3·49	91·02	89·16	9·39
1925	12·93	15·51	3·10	92·68	90·80	8·82
1926	13·08	15·76	3·21	92·19	91·50	8·70

Prior to 1911 the mill was an 8-roller one, consisting of a Krajewski and two 3-roller sets ; in 1911 two more 3-roller sets were added making the mill a 14-roller one.

ST. KITTS.

The position as regards sugar production in St. Kitts is entirely dominated by the Basseterre factory which now handles all the cane grown in the island as well as dealing with a small quantity from Nevis ; as this is one of the best equipped and most up-to-date factories in this region some account of its work may usefully be recorded.

During the year the circuit of the factory's railway around the island has been completed, so that railway transport is now available for every estate, transportation difficulties thus being decreased.

In 1926 this factory turned out 16,290 tons of sugar from 143,552 tons of canes,[1] this being the largest crop yet made.

The following table contains an abstract of the main features of the work of this factory during 1925 and 1926. The higher fibre content of the canes in 1926 will be noted, and the effect of this on the recovery of

[1] Tons of cane reported as reaped 143,718
Tons crushed at factory, as chemist's report 143,552

Difference; deduction for burned cane.. .. 166

sugar from the canes, which was slightly below that of 1925 although the mill work was as good.

	1926		1925.
Tons cane per ton sugar	8·81	..	8·35
Cane—Sucrose per cent.	12·44	..	13·07
„ Fibre „	15·11	..	13·88
Bagasse—Sucrose per cent.	2·41	..	2·48
„ Fibre „	51·72	..	51·47
„ Moisture „	44·89	..	45·13
Sucrose in juice per 100 sucrose in cane	94·33	..	94·89
„ sugar „ „ juice	92·90	..	92·68
Commercial sugar „ „ juice	96·66	..	96·58
„ „ „ cane	91 19	..	91·61

As was recorded with reference to this factory in 1925,[2] the filter-presses have been entirely discarded, except in the process of the final cleaning up of the factory at the close of the crop; all scums are now returned to the juice from the last mill and used with this in the process of maceration.

The milling equipment of this factory remains practically as originally installed, i.e., it possesses a Krajewski crusher, followed by four 3-roller sets of mills and is thus a 14-roller plant. To this equipment there was added this season two sets of revolving knives, one set at the foot of the cane carrier to level the canes and the other at the top as a preparatory cutter for the crusher. It will be observed that the mill work is good, 94·33 per cent. of the sucrose in the cane being recovered in the juice. It is recorded that the boilers steam well, the bagasse being more than sufficient for producing all the steam required; indeed one of the prob'ems presenting a little difficulty is the disposal of the surplus bagasse. Its conversion into farmyard manure by the Adco process, or perhaps, preferably, by the Mauritius process referred to above, will, doubtless, have consideration. A new 12 ft. calandria vacuum pan was installed to meet the increasing output. The condenser water is cooled by the spray system; in this connexion two new centrifugal pumps driven by high-speed vertical engines were installed for the 1926 crop to replace the pumps formerly in use. The equipment of the factory is thus being kept well up to date and its efficiency maintained at a high level..

For the crop of 1926 there were reaped in St. Kitt's 143,178 tons of canes, including plants and ratoons, from 6769 acres, equivalent to 21·15 tons per acre, an amount somewhat in excess of that of the previous year.

A year or two ago a little trouble was experienced from the presence of mosaic disease, but this appears to have been completely eradicated; now, however, a small amount of "gumming" disease exists particularly amongst certain varieties of canes. For this reason the acreage under White Transparent is being reduced and H 109 and Ba 6032 are being discarded. The last-named cane is said to be tolerant of the disease, but acts as a carrier and is therefore dangerous.

St. Lucia.

St. Lucia was amongst the first British colonies to adopt the central factory, or usine, system of handling its sugar crop, but the factories there have never attained any large size and the industry remains a comparatively small one; it is carried on in four small factories whose aggregate output is in the neighbourhood of 5000 tons, being estimated at 5550 for the crop of 1926. A small quantity of muscovado sugar is also produced, much of

[2] *I.S.J.*, 1926, p. 21.

which is consumed locally. In addition, a certain amount of syrup or fancy molasses is manufactured for export to Canada, the quantity being 153,400 gallons in 1925 while that produced in 1926 is estimated at about 100,000 gallons. With the low prices recently realised for syrup there is an increasing tendency for the smaller cane growers to sell their canes to the sugar factories.

OTHER B.W.I. ISLANDS.

The cultivation of the sugar cane is now carried on to only a small extent in the islands of Montserrat, Dominica, St. Vincent and Grenada. A small amount of muscovado sugar is made in Montserrat and St. Vincent, and in Grenada a small quantity of crystal sugar is made for local consumption. In St. Vincent the production of syrup engages some attention, but the industry is of little more than local interest; it serves, however, to supplement the cotton, arrowroot and cacao industries of the colony.

The condition of the sugar industry in these small islands marks the effect of the struggle against the subsidized beet sugar industries prior to the coming into effect of the Brussels Convention. In the early part of the nineteenth century and the years preceding, these islands were mainly supported by their sugar.

The Power Producing Cane Sugar Factory.

G H W. BARNHART.

The quantity of electrical energy produced by cane sugar factories for outside consumption depends in a great measure upon the extent to which the extra use of steam is practised. This expression has been contracted in general usage to "extra steam" and the practice has been made use of solely in the interests of fuel economy. The economy of the extra use of steam over the older methods is apparent, and it is evident that in factories using extra fuel this economy is, or should be, practised to the highest extent. While practically all cane factories utilize the bagasse from their mills as their main and sometimes only source of fuel, considering it as a waste and useless by-product which is most easily and economically disposed of by burning in the generation of steam for factory purposes, the use of bagasse directly at the present time in the manufacture of paper and other cellulose products, and its probable extended use, points to the time when it will pay to sell this bagasse for such purposes, and to purchase standard fuel for steam generation purposes. The use of bagasse indirectly in the generation of electrical energy for outside consumption is a practice which has become general in the larger Hawaiian factories. Under these conditions the bagasse has a definite value, and the oil or coal equivalent a definite cost, so that any reduction in the fuel bill of a factory through the economical use of steam will reflect itself in increased profits.

The extra use of steam has been carried still farther in many factories. Among these uses may be mentioned the extraction of vapour from any or all of the bodies of a multiple effect evaporator for heating, reheating or boiling. In most cane sugar factories, however, the extra use of steam has been limited to the production in a pre-evaporator of vapours for heating and possibly reheating. Owing to the fluctuating nature of the demand for steam by pans, it has been thought inadvisable to connect them up with any extra steam method, owing to the perturbations resulting in factory work and the increased cost of the closer supervision necessary. Analysis

of this phase, however, indicates that the misapprehension is unfounded. In general, the main source of steam for heating, reheating, evaporating and boiling is the exhaust steam from the mill engines, factory turbine and other apparatus. Where this supply of exhaust steam is sufficient or more than sufficient to satisfy the requirements, there can be no object in attempting the extra use of steam, for there would be an excess which must blow off into the atmosphere. If, however, the supply of exhaust is insufficient, it will be profitable to resort to the extra use of steam, and in general this use will be profitable where steam has to be taken directly from the boilers for heating purposes.

Proper consideration in the choice of mill engines, choosing so that they will be as economical of steam as is reasonably possible; installing motor-driven pumps in place of direct-acting units; installing motors to drive centrifugals, crystallizers, shredder, knives and other equipment; choice of proper size of live and exhaust steam piping so as to minimize heat losses; choice of steam end for the electric generator, and of mill boiler pressure; all these have their effect in reducing the quantity of exhaust steam produced in a factory. To properly utilize this steam, heating surfaces must be amply large so as not to be rendered insufficient as scale or incrustations accumulate. Heating surfaces in pans must be amply large to permit of boiling throughout a strike with exhaust steam, and strikes must overlap, there being preferably at least three pans for boiling commercial sugar. The weight of bagasse as influenced by the percentage of fibre in cane has much bearing on whether a factory needs to burn extra fuel. Assuming a uniform moisture content of 42 per cent. in bagasse, with 10, 12 and 14 per cent. fibre in cane, each 100 tons of cane per hour will produce 18·2, 21·8, and 25·45 tons of bagasse respectively, or 20 per cent. more in the case of 12 per cent. fibre, and 40 per cent. more in the case of 14 per cent. fibre in cane. Furthermore, the moisture content in bagasse has an influence on the net available B.T.U., and also on the efficiency of combustion in the generation of steam. With 38 per cent. moisture there are 5022 B.T.U. available, with 42 per cent. 4618, and with 45 per cent. only 4455 per lb. of bagasse. The evaporation with 500° F. flue gases and 12 per cent. CO_2 and other data follow :—

Bagasse.			Steam.	
Per cent. Moisture.	Available B.T.U. Per lb.	Per cent.	Lbs. F/A. 212° F.	Per cent.
38	5022	100·0	3·29	100·0
42	4618	91·9	3·00	91·2
45	4455	88·8	2·77	84·5

Tons of steam F/A 212° F. will be produced as follows, as per cent. fibre and flue gas temperature varies :—

Moisture.	10 per cent. Fibre.			12 per cent. Fibre.			14 per cent. Fibre.		
Per cent.	500°	600°	700°	500°	600°	700°	500°	600°	700°
38	55·80	52·55	49·30	67·00	63·60	59·20	77·75	73·28	68·80
42	54·60	51·30	48·00	65·60	61·62	57·65	76·40	71·80	67·20
45	53·35	50·02	46·70	64·10	60·12	56·15	74·60	70·00	65·40

It will be noted that a factory grinding 100 tons of cane per hour will produce 46·70 tons of steam F/A 212° F. with 10 per cent. fibre in cane, 45 per cent. moisture in bagasse, and 700° F. flue gases, and 77·75 tons of steam with 14 per cent. fibre in cane, 38 per cent. moisture in bagasse and 500 °F. flue gases. As will be seen later, the former condition will not supply sufficient steam for ordinary conditions, i.e., when all heating and reheating

and boiling is done with exhaust steam and evaporation is done at quadruple effect. The latter will supply steam for triple effect evaporation with much to spare. As the latter condition is rather unusual, and the former one a possibility, particularly on an irrigated plantation grinding at a high rate, it is advisable to design and arrange equipment to comply with this condition, as the moisture content in bagasse may be higher at times and the flue gases are liable to run above 500° F., if the heating surfaces are fouled or there is an insufficiency. For the conditions usually encountered, the following weights of exhaust steam in tons per hour will be required in a factory grinding 100 tons of cane per hour :—

	Triple		Quadruple		Quintuple
Heating	13·54	..	13·54	..	13·54
Reheating	1·20	..	1·20	..	1·20
Evaporating	35·31	..	26·48	..	21·18
Boiling	9·19	..	9·19	..	9·19
	59·24	..	50·41	..	45·11

A pre-evaporator supplying vapours for heating and reheating would reduce these requirements to 54·32 for triple, 46·72 for quadruple, and 42·17 for quintuple effect evaporation. An extreme case in which vapours are drawn from all effects where possible for heating and boiling in stages, would require 34·76 tons per hour. A recent compilation of data on Cuban centrals indicates that the capacity of the mill electric plant must be equivalent to 0·2 K.W. for each ton of cane ground per day. For instance, a factory grinding 100 tons of cane per hour would require a capacity of 480 K.W., not providing for electric drive for the rollers or shredder. The latter would require approximately 1 K.W. per ton of cane ground per hour, probably slightly over 100 K.W., so that the total capacity should be in the neighbourhood of 600 K.W.. or 6 K.W. per ton of cane ground per hour. As a great many of these plants are called upon to supply a lighting and miscellaneous load in addition, and as the larger factories can, under favourable conditions, absorb the exhaust steam from a load up to 5 K.W. per T.C.H. in excess of the load utilized by the factory, it is advisable to make provision for this outside load in designing the power plant. Consequently the rating can be raised to 11 K.W. per ton of cane ground per hour. It will be shown that this rating will depend entirely on the extent to which the extra use of steam is practised in the factory. Evidently quadruple effect evaporation without further recourse to the extra use of steam will permit of carrying a considerable outside load. This may vary from 1 K.W. per T.C.H. for a factory which is unfortunate in being hampered with equipment that produces an undue quantity of exhaust, to 5 K.W. or even more, where conditions are favourable. As the degree to which the extra use of steam is practised approaches, or even goes beyond, the practical limit, the advantage of a non-condensing unit to furnish the exhaust necessary to supplement factory requirements, together with a condensing unit or units, to supply whatever additional power may be needed in the factory, and more to satisfy outside requirements, becomes apparent

A factory handling cane of 12 per cent. fibre, the bagasse having a moisture content of 42 per cent., flue gas temperature being 500° F., and CO_2 content 12 per cent., should produce on an average 65·6 tons of steam per T.C.H. F/A 212° F., or 63·0 tons of steam at the usual boiler pressure. The requirements when applying the principle of extra steam to quintuple effect evaporation with pre-evaporator supplying vapours for heating and

reheating, are 42·17 tons per hour. With a 10 per cent. shrinkage in exhaust due to condensation and radiation, the actual steam consumption by mill engines, power plant, etc., to supply this quantity of exhaust would be 42·17/0·90 = 46·85 tons per hour. In other words, a surplus of 16·15 tons of steam is available provided all bagasse is burned under the boilers. The power that can be generated in a condensing unit is 16·15 × 2000/22 = 1468 K.W. The power which would be developed in the non-condensing unit under these same conditions would vary from a deficiency of 266 K.W. to a surplus of 134 K.W. over factory requirements, depending on whether or not the factory is hampered with equipment tending to produce an abnormal quantity of exhaust. In other words, when the non-condensing unit is operated to supply just enough exhaust to supplement factory requirements, there will be power available for outside consumption amounting to anywhere between 1202 and 1602 K.W., the latter being under favourable conditions which *can* be controlled. In the extreme case mentioned above, there would be slightly more than 2000 K.W. available for outside consumption.

If the factory were to burn all of its molasses in addition, a further increase in power would result. Roughly, a ton of bagasse, a ton of molasses, and 1·4 barrels of fuel oil have the same fuel value in terms of steam produced, and this will be approximately 2·88 tons at boiler pressure. The weight of molasses produced by a factory depends on many factors, among the principal ones being cane polarization and purities of syrup and final molasses. Molasses per cent. cane readily range from 2·5 to 5·0, depending on the above. Assuming 3·0 as a fair average, the molasses from 100 tons of cane will produce 100 × 0·030 × 2·88 = 8·64 tons of steam, which in turn will generate 8·64 × 2000/22 = 785 K.W. hours, the average increased output being 785 K.W., or a total of 2387 K.W. for a 100-ton factory with quintuple effect and pre-evaporator supplying vapours for heating and reheating.

It will be noted that as the application of the principle of extra steam is extended, the quantity of steam or vapour required for processing is decreased. As the mill, electrical and miscellaneous loads remain constant, or practically so, it is evident that the exhaust from some unit or units must be curtailed to maintain a balanced condition. The logical place for this is in the non-condensing electrical unit, and from supplying energy equivalent to as much as 5 K.W. per T.C.H. for outside consumption under favourable conditions and quadruple effect evaporation, this output will be decreased to approximately 1 K.W. per T.C.H. under the same favourable conditions, but with a quintuple effect and pre-evaporator supplying vapours for heating. Another phase of direct importance in this connexion is the reduction in injection and air pump capacities required as the principle of the extra use of steam is extended. Below are the calculated average quantities of water required (in M.G.D.), and vacuum pump displacements (in C.F.M.) for a factory grinding 100 T.C.H. with temperature of injection water at 80° F.

Exhaust steam to	Injection Water M.G.D.		Air Pump Displacement C.F.M.
Triple, heater and pans	9·24	..	5490
Triple, pre-evaporator and pans (vapour to heaters)	8·22	..	4880
Quadruple, heaters and pans	7·40	..	4400
Quadruple, pre-evaporator and pans	6·77	..	4020
Quintuple, heaters and pans	6·72	..	4000
Quintuple, pre-evaporators and pans	5·70	..	3390
Quintuple effect and complete extra use of steam	4·15	..	2470

The maximum instantaneous injection water demand when placing a pan in service might easily be 60 per cent. in excess of the averages given. The figures given indicate the power which can be expected when the factory is in operation. Evidently there are stoppages due to breakages, to lack of cane, and to the usual week-end shutdown when the continuity of power production would be interrupted unless sufficient bagasse were in reserve or molasses stored up during the week were drawn upon. During the off-season other fuel would necessarily be used and combination furnaces fitted under the boilers or else separate boilers supplied for bagasse, molasses and fuel oil (or coal) burning. While the economies indicated appear to be considerable, the fact that they are not continuous throughout the year will have much to do with a choice of generating equipment. On an irrigated plantation depending on pumps for its water supply, the demand for power is generally slight during the winter months, medium during spring, and heavy during summer, easing off gradually through autumn. As in Hawaii harvesting generally commences, or should commence, in the latter part of November or early part of December, complete advantage of this surplus power could not be taken in the first months of grinding, and bagasse and molasses would have to be stored, to be later brought back for burning. Finally, harvesting generally comes to an end just after the heaviest demand commences. However, it is probable that this plan would work in well with other schemes for supplying the necessary power during the off-season. Furthermore, while the conservation of bagasse or molasses may not be desired, it is reasonable to arrange equipment, not so that there will be just a sufficient amount of bagasse to "worry along on," but so that there will be a decided surplus to take care of any emergency.

Brevities.

The Physical Society, London, has awarded the 4th Duddell Medal to Mr. F. TWYMAN, F.R.S., Managing and Technical Director of Hilger, Ltd., London, for meritorious work on scientific instruments and materials.

Among companies recently registered in the U.K. are the following : King's Lynn Beet Sugar Factory, Ltd., 6, Lancaster Place. Wellington Street, Strand, London, W.C.2. (No. 219,365). Public Company ; Nominal Capital, £450,000 in £1 shares.

A yield of 28·6 tons of beets per acre containing 17·4 per cent. of sugar is reported from King Island, Stockton, Cal., U.S.A., under the auspices of the Holly Sugar Co.[2] The Wright Corporation, owning Delta land in Contra Costa, San Joaquin, and Solano counties also report a remarkable yield, viz., 23 tons to the acre.

The British Sugar Beet Society announces that the Mason Challenge Cup has been awarded this year to Mr. S. MINTER, of Parham, Suffolk, a grower for the Ipswich factory, whose crop of sugar beet shewed an average yield of 16·17 tons per acre, with an average sugar content of 19·10 per cent. The competition was again open to all growers of not less than five acres for any of the existing factories in the United Kingdom.

Prof. Dr. ALEX. HERZFELD, who for many years has held the position of Director of the Institut für Zuckerindustrie, Berlin, with such distinction, has now retired, though he still retains the editorship of the *Zeitschrift*, the organ of the Institut. Dr. Herzfeld's post is now held by Dr. SPENGLER, a chemist with a distinguished record in the dyestuff and metallurgical industries, who in collaboration with others, has published several papers of interest dealing with sugar technology.

[1] *Cf.* also *I.S.J.*, 1925, 588 ; 1926, 160. [2] *Western Irrigation*, December, 1926, p. 7.

Brevities.

In Hawaii, the variety H 109 now occupies 42·7 per cent. of all cane land in the Islands; Yellow Caledonia, 27·9; D 1135, 14·8; Yellow Tip, 3·2; Lahaina now only 1·1 and other varieties 3·9 per cent.

The sugar crop of the Dominican Republic for 1926-27 is estimated at 424,601 short tons, as compared with 394,033 tons in 1925-26. The area under cane has been increased by some 2300 acres; and the condition of the canefields ranges from fair at a few centrals to good in most districts.

Messrs. DUNCAN STEWART & CO., LTD., Glasgow, were responsible for the erection in this country of three beet sugar factories during 1926, at the same time supplying all the sugar machinery needed. These factories with their capacities were: Cupar, Fife (500 tons); Felstead, Essex (500 tons); Poppleton, Yorks. (1000 tons).

The imports of sugar into Switzerland during 1926, according to BRUNNER & BOSER, of Zurich, came to 128,835 metric tons, as compared with 129,030 tons in 1925. The bulk of this was crystallized sugar, and came mostly from Czecho-Slovakia, though Germany and Belgium sent appreciable quantities.

According to the *South African Sugar Journal*, the La Mercy Estate, Ltd., a sugar factory 23 miles from Durban, which was purchased by a syndicate about 6½ years ago for £325,000, and recently went into liquidation, was sold by order of the liquidator and fetched only £80,000. It has a capacity of 21 tons of cane per hour and is reported to be fully equipped for making a high-class mill white sugar.

The second official estimate of sugar production in Formosa for the year 1926-7 places the output of centrifugal sugar at 6,814,582 piculs (say 405,600 tons) and that of brown sugar at 156,864 piculs (about 9800 tons). Should this estimate prove justified, the decrease in production of centrifugals as compared with the previous year will amount to over 1,300,000 piculs (73,600 tons). This is said to be mainly due to a falling off in the area planted to cane owing to the competition of rice. The cane area this year is put at 228,852 acres, as compared with 260,993 acres in 1925-26.

A railway rates judgment. relating to a carriage charge for sugar, which was taken to the supreme court of appeal, the House of Lords, was recently decided in favour of the Railway Company. But its relation to sugar was very incidental, as though a charge for the carriage of that commodity was made the basis of the trial, the real issue was whether the Railway Company was entitled to raise its charges for freight all round, on the strength of certain powers it claimed to possess. The millions reported in certain press organs to be at stake related to freights generally for goods carried on rail.

The public issue of shares in the Lincolnshire Beet Sugar Company, Ltd., last month did not catch the favour of the investing public nearly as much as was hoped, inasmuch as 90 per cent. of the shares had to be taken up by the underwriters. But amongst contemporary flotations, more than one other went badly also, which suggests that investors, if nowadays more numerous than they used to be, are also more discriminating in their choice of shares. However, this particular sugar company has been promoted by able interests that ought to make a success of it, if it is at all possible to succeed with a beet factory in this country.

Sulphur dioxide has been the subject of enquiry in respect of its poisonous nature when inhaled.[1] Present in the air in a concentration of about 0·0005 per cent. it only affects the eyes and smell; at one of 0·012 to 0·015 per cent. it begins to produce irritation of the trachea and bronchi; while 0·05 per cent. is sufficient to cause a sensation of suffocation and practically to prevent breathing. There exists some evidence to show that among workers exposed to the fumes of SO_2 influenza and catarrh are less prevalent, while tuberculosis (excepting fibroid phthisis) appears to be non-existent. Further evidence is yet required, however, to enable definite conclusions on this point to be reached.

[1] *Industrial Chemist*, 1927, 84.

American Factors, T.H., have published a photograph of two stands of cane, each 22 ft. high, grown on land belonging to the Makee Sugar Co., one containing 39 stalks grown from one piece with one eye, and the other with 41 stalks from one piece of cane with two eyes.[1]

F. HOMMES[2] found that the cane variety EK 2 and certain others kept better when stored in the factory yard in the shade than in the sun. This, however, was not found to be so with some other varieties examined, the tests indicating little or no advantage with these.

The calculating disc for rapidly ascertaining purity values from the density (Regie degrees) and the polarization per 100 c.c., which has been put on the market by the well-known seed growers, Vilmorin of Paris, is highly recommended by Mr. E. SAILLARD. It is about 13 in. in diam., and weighs about 11 lbs.

A very vigorous campaign against malaria will be conducted by the Philippine health authorities with funds recently voted by the Legislature amounting to 100,000 Philippine dollars. Units are being assigned to strategic points, and within certain areas a systematic eradication will be conducted with the aid of Paris Green. The mortality due to this disease in the P.I. is at present as high as 30,000 a year.

Carbon dioxide condensed to the solid state is on the U.S. market under the name of "dry ice." Owing to the fact that its latent heat in passing from the solid to the gaseous state is nearly twice that of water-ice in melting, it possesses many advantages over the latter refrigerant, against which it is able to compete, though its price is approximately ten times higher. In its manufacture, the pure gas prepared from carbonates must be used.[3]

It was brought out in discussion at the last meeting of the Association of Hawaiian Sugar Technologists that there are likely to be considerable amounts of molasses available as fuel next year, as it is no longer profitable to ship it to the mainland. It was stated that the most satisfactory way to burn molasses is to mix it with the bagasse. Formation of clinkers when molasses is burned is not very serious in well designed furnaces.

A London firm of engineers constructing evaporators on the thermo-compression principle now claim to have evolved a heat-pump which will produce economically a sufficient increase in the temperature of the evaporating vapours to provide an effective, though comparatively small, thermic head. The heat pump may either be operated by high pressure steam, preferably at about 10 atmos., or it may be an electrically-driven turbo-compressor.

A British engineering firm after having investigated economical and efficient methods of drying beet pulp in Italy for its working up to sugar, according to the De Vecchis or other process, two years ago obtained an order for a large scale plant which was erected at Sanguinetto. Now a second order for a dryer of the same but larger type has been obtained, the first plant having proved to be satisfactory for the purpose. Cossettes stored from last season under technical conditions were found after 12 months to be in exactly the same state of preservation as when discharged from the machine. They will be worked up to sugar when the rest of the factory plant at Sanguinetto has been completed.

Professor SCHMIDT of the University of Illinois,[4] in attempting to develop a relation between varying thicknesses of scale and heat losses, takes into consideration also the structure of the scale as well as thickness. Considering scale of ordinary thicknesses varying up to $\frac{1}{8}$ in., the loss in heat transmission may vary in the individual cases from insignificant amounts to as much as 10 or 12 per cent. The loss increases somewhat with the thickness of the scale, but the mechanical structure of the scale is of at least as much importance as the thickness in producing this loss. J. S. SHEAFE points out that, with a scale as thick as $\frac{1}{2}$ in., the loss (71.14 per cent.) is approximately only five times as great as at $\frac{1}{16}$ in. thickness (14·9 per cent).

[1] *Sugar News*, 1927, **8**, No. 1, 53. [2] *Archief*, 1926, **34**, 545-551.
[3] *Ind. Eng. Chem.*, 1927, February. [4] *Sugar*, 1927, **29**, No. 1, 29-30.

Review of Current Technical Literature.[1]

PHILIPPINE MILLING NOTES (CONVEYORS). **Theo. Nickelsen.** *Sugar News*, 1926, 7, No. 7, 462-463.

There are many points that may be found helpful to the mill engineer in the design of the machinery for the conveyance of the bagasse from mill to mill. No doubt all sugar mill engineers have had trouble with these intermediate conveyors, and some of the older type of apron conveyors have given a lot of trouble, and at times some of the more modern types are not without their little peculiarities. Past experience shows that the majority of these conveyor troubles were traceable to mill settings rather than to fundamental defects in the design of the conveyor. Nevertheless, some of the older, as well as some of the newer types are faulty in detail. More often than not, the breakage of intermediate conveying machinery can be traced to the mill ahead not feeding properly, or scraper troubles of the rollers behind; thus causes of conveyor breakages are often looked upon by the operator as an inherent fault in the construction of the conveyor itself, when in all probability the cause can be traced to some outside factor. Apron conveyors as built for Cuban mills are now of the three and four chain steel slat variety, and have quick detachable coupling links either on every link, or on every third or fourth link only, which enables a quick change of a new section to be effected when breakages occur. The old type of apron conveyor was often as not rivetted to two chains with one detachable link only provided in its entire length, and when a break occurred it meant the cutting out of 12 to 18 steel rivets from 5 to 6 slats to enable one new one to be inserted, and a loss of some three hours was heralded on the board as a result of stoppages of this nature. These conveyors also had the unpleasant habit of doubling themselves up between the main drive shaft sprockets, and the idler guide shaft sprockets, delaying the milling considerably, this being often caused by too large a feed for the mill setting ahead, or some fault in the mill scrapers, or returner-bars. These delays have now been eliminated by a better design of apron conveyors, and better milling practices; while juice grooves have also done much to eliminate intermediate conveyor troubles by smoother feeding, thereby decreasing cane jams. Another type is the Ewart slat conveyor, which has much to recommend it. It has been in use in the Philippines, and has proved itself, in many ways, superior to other types in the Islands. Its one great advantage is in curtailing the loss, by dripping, of the applied maceration water, and also its ability to handle the bagasse or partly crushed cane in large, overload quantities, together with maximum macerations. When difficulties have been experienced with this conveyor it has been found that it was generally caused by a detail defect in installation, operation, in scraper trouble of mills behind, or mill settings ahead, rather than with the conveyor itself. This conveyor is very susceptible to breakages where the discharge scraper of the preceding mill is not functioning properly, as in this case the bagasse adheres to the roller, or is packed between the loosely fitting scraper, and top roll, and does not let go until a large amount has accumulated, which on dropping in front of the conveyor may fall to one side only, causing the conveyor to lift at such an angle as to cause chain breakages. Again the moving slats of the carrier may be raised to such a height, owing to the momentary excessive thickness of the blanket, as to cause the conveyor to strike against some obstruction above. Another advantage in this conveyor is that additional slats can be added, and a slightly accelerated speed given, so that a constant thinner blanket is presented to the mill ahead, thus avoiding a cause of mill chokes. The Ewart type also offers efficient methods of maceration of the moving blanket of bagasse both from above and underneath; with steam, hot or cold water, or a combination of the three, which is always a boost to the extraction figures. It is well to point out a very important item in relation to the good working qualities of the Ewart conveyor, namely, that the slats of the conveyor should be made to operate as close to the discharging mill as possible, so that the bagasse issuing from the rollers is taken by the conveyor slats immediately, thus avoiding having to be pushed forward by the action of the rollers some little distance, to meet the

conveying slats, which is the case where the conveyor has been made too short. The observance or non-observance of this point means a smooth or troublesome running conveyor. There is one other class of conveyor at work in one of the Island mills, developed in Hawaii by MEINECKE, which has one strong feature to recommend it, namely, that there are no moving parts to break or wear out, and a stoppage, due to this method of conveyance of the cane or bagasse from mill to mill, is generally traceable to scraper troubles, which are often caused by some foreign matter entering with the cane, smashing the grooves of the rollers, and thereby damaging the scrapers.

DESTRUCTION OF SUGAR DURING THE EVAPORATION OF JUICE AT HIGH TEMPERATURES IN THE BEET SUGAR FACTORY. **Ph. Orth.** *Bulletin de l'Association des Chimistes de Sucrerie de France.* 1926, **43**, 458-488 ; **44**, 5-12.

Evaporation at high temperatures in the beet factory has gradually extended during recent years, by reason of the economy of fuel which it permits ; but undoubtedly against this saving of fuel one must balance the loss of sugar that occurs. Determination of the amount of sugar destroyed during evaporation is, however, by no means the easy matter it might appear to be at first thought. Everyone is acquainted with Herzfeld's tables for estimating this, but these were established with pure solution in laboratory tests, and HERZFELD himself has taken care to point out that on the industrial scale the actual loss of sugar may be much greater. He has, in fact, estimated that in the factory the destruction of sugar in the evaporators may be something like ten times more than was indicated by his small-scale tests. Mr. ORTH, Manager of the Ste. Juste sucrerie, France, has taken up the matter with considerable thoroughness. He has constructed for his experiments a special apparatus (having a calandria with 16 steel tubes, 20 mm., and a central tube, also in steel, 120 mm. diam.), so designed and operated as to observe alterations in the refractometric purity, while keeping the refractometric dry substance constant all the time.[1] To this end, the condensed vapours were returned to the apparatus, and the juice concentration maintained approximately constant, no juice being drawn in after the commencement of the test, the strongly ammoniacal waters only being separated, since in practice both ammonia and carbon dioxide are eliminated in the early stages of concentration. A number of experiments were conducted with second-carbonated juice from the factory sulphited to the desired alkalinity, and also with a syrup. which after dilution had been filtered over animal charcoal, and had also been adjusted with soda or sulphurous acid gas. In these experiments all possible factors bearing on sugar destruction were considered, viz. : time ; alkalinity and *pH* value ; temperature ; local superheating ; sugar concentration ; etc. Vapour temperature observations were made every five minutes ; fresh juice from the factory was used for each experiment ; and the losses were observed every ¼ hour at temperatures varying from 108 to 135°C., these being determined by the double polarization method. At the same time the relations between the sugar destruction and the coloration of the juice, as well as variations in the cupric reducing power were examined. It was, however, found difficult to arrive at an exact estimation of the actual losses occuring, owing to the production during heating of dextro-rotatory substances, which quite vitiated the determinations made polarimetrically, these behaving in fact like raffinose, for which in fact they have often been mistaken. Nor was it possible to arrive at reliable results from the determination of the reducing power before and after inversion, since reducing substances had also formed to disturb this assay as well. It remained therefore to draw conclusions from the minimum values for the destruction of sugar obtained by the double polarization method, and tabulated and plotted in this article. And the nett conclusion arrived at is that, owing to the considerable destruction of sugar under the conditions of evaporation at high temperature, it is uneconomical to work at degrees over 115°C., the loss in the yield of sugar exceeding the saving in coal roughly in proportion as this temperature is exceeded.

[1] *Zeitsch. Rubenzuckerind*, **43**, 75.

"BOLTING" IN SUGAR BEETS. J. A. Voelcker. *Journal of the Ministry of Agriculture, January,* 1927, 889-890.

"Bolting," or running to seed, of sugar and mangold beets is not an uncommon occurrence, and though the cause is not definitely known, and while, undoubtedly, it is more prevalent in some seasons than in others, the tendency to "bolt" is generally associated with early sowing. It is possible also that "bolting" depends to some extent on the variety and source of the seed. Of late the subject has become of some importance in connexion with sugar beet cultivation, inasmuch as the factories have advised the exclusion of any roots that have "bolted." Having grown, during this past season, at the Woburn Experimental Farm, crops of beets and mangolds on the same land, and some of the plants having in each case "bolted," Dr. VOELCKER thought it would be of interest to take, from the crops, representative samples of sound and "bolted" roots, and to compare them in respect of their analytical composition Mangold seed was sown on the drills on May 8th, the variety being "Lord Warden"; manures were applied before sowing, and a top-dressing of nitrate of soda given on July 5th. The number of "bolted" plants was by no means large, and on November 2nd four roots of each kind were selected for analysis. Beet seed was sown on the flat on May 20th, the manures being applied before sowing. Comparatively few plants "bolted," and the "bolting" did not occur in the early stages, but in the late period of growth only, so that the typical roots selected for analysis were not inferior to the others, but indeed weighed more. The roots were selected on November 2nd. The four lots of samples were then analysed and gave the following results :—

	SUGAR BEET.		MANGOLDS	
	Sound Roots per cent.	"Bolted" Roots. per cent.	Sound Roots, per cent.	"Bolted" Roots. per cent
Water	75·40	77·65	90·27	77·65
Sugar	17·50	16·50	6·20	4·80
Fibre	0·96	1·16	0·60	0·74
Mineral matter	0·69	0·88	1·22	1·30
Weights of roots (washed and trimmed)	lb oz. 6 4	lb. oz. 7 6	lb oz 15 6	lb oz. 16 3

The "bolted" sugar beet, while giving over 2 per cent. more water and slight increases in fibre and in mineral matter, showed a reduction of 1 per cent. only in the sugar content. It would not appear, therefore, that the quality of "bolted" sugar beet is so much lessened as to necessitate the exclusion of such roots from what is despatched to a factory, at least when the roots, as in the above instance, have not visibly suffered in size. In the case of the mangolds the differences in water and in mineral matter were immaterial; the fibre, however, was rather more in the "bolted" roots, which showed a loss of 1·4 per cent. in sugar.

JUICE FROM MILLING PLANT TO EVAPORATOR SUPPLY TANK (THE PETREE PROCESS). J. N. S. Williams. Report of Committee on Sugar Manufacture of the Hawaiian Sugar Planters' Association (here abridged).

Continuous settling, which was practised in Hawaii some 25 or more years ago, but was generally abandoned in favour of intermittent settling, has been again introduced in the Petree-Dorr Process, which system provides for a continuous stream of limed and heated juice entering the apparatus, a continuous withdrawal of clear juice going into process in the factory, and a continuous withdrawal of mud. Three of these apparatus are at work in these Islands at present. The ordinary or intermittent type of settling tank is generally used in the Territory, in the operation of which the mud or feculent matter settles to the tank bottoms, which are cone-shaped, and after the clear liquor has been drawn off, the residues are discharged and dealt with as hereinafter described. But the juice which reaches the evaporator supply tank is never as clear as the best juice in intermittent settling tanks because of the practical impossibility of stopping the draft of clear juice when the zone of cloudy or unsettled juice near the bottom of the tanks has been reached. This is a

recognised defect in the intermittent settling tank, to minimize which tanks are made in some instances of very large diameter and comparatively shallow, as at Ewa Plantation, or of smaller diameter and very high, as at Oahu Sugar Company's factory and at other places. Now, one of the advantages of the Dorr settling tank is that nothing but the clearest juice is drawn off excepting when liquidating at the end of a period of operation. In the Petree-Dorr process which has been adopted by three establishments in the T.H., and has been installed in considerable numbers in Cuba and elsewhere in cane sugar countries, the muds from the Dorr continuous settling tanks are returned to the crushing equipment and are distributed on the bagasse issuing from the first and second sets of rollers. This at one automatic operation disposes of the residues from clarification, since the bagasse after having absorbed the muddy liquid from the settling tanks is passed through the following sets of rollers, the juice squeezed out, leaving the greater portion of the mud in the bagasse, which is then conveyed to the furnaces and disposed of at minimum cost. The Petree-Dorr process has certainly simplified manufacturing operations and has undoubtedly reduced cost by reason of the reduction in the labour employed and material used. There can be little doubt that on constructing an entirely new factory the Petree process would, in the minds of many, if not most designers, be preferred to ordinary settling tanks, filter-presses and the equipment and labour required to move the larger quantities of filter-press residues. The question of the translucence and limpidity of original juices is being discussed and the following quotation epitomizes the general view: "Any one familiar with the manufacturing of beet sugar will at once acknowledge that the earliest and most careful removal of impurities from the sugar solutions is essential to the production of the highest yield of sugar." It will be found, one believes, that those factories which pay closest attention to this matter are the ones which have the highest recovery of sugar from that in the juice.

SUGAR BEET AND SOIL FERTILITY. **A. Bridges and P. N. Dixey.** *Journal of the Ministry of Agriculture*, 1927, 33, No. 11, 1031-1035.

If the farms of a special nature, such as sewage farms, are excluded, it is shown that 3640 tons of washed sugar beet, representing 31 crops were sent away from 345 acres. Now, in order to secure this crop, these farmers applied 999 tons of farmyard manure, 199 cwt. of sulphate of ammonia, 151 cwt. of nitrate of soda, and 90 cwt. of nitrate of lime, giving a total addition to the soil of about 22,700 lb. of nitrogen. They also applied 584 cwt. of kainit and 211 cwt. of muriate of potash, which, together with the potash in the farmyard manure, would account for about 28,000 lb. of potash. In addition, 1078 cwt. of superphosphate of lime were applied to this crop, giving, when taken with the farmyard manure, some 21,600 lb. of phosphoric acid. There were also used 227 cwt. of special sugar beet manure and 90 cwt. of shoddy, and these have been taken at average analyses. It has been assumed that the tops and leaves of the beet would be returned to the soil, and accordingly no deduction has been made for the manurial constituents contained in them. In cases where they are fed to stock there would be a small loss to the solid through the sale of meat or milk, and the process of dung-making. These farms, taken as a whole, gained rather than lost fertility to the extent of 29 lb. per acre of nitrogen, 15 lb. per acre of potash, and 47 lb. per acre of phosphoric acid, as a result of growing sugar beet. A consideration of the farms, when grouped according to whether the crops were grown with farmyard manure or with artificials only, however, shows that a favourable result as regards soil fertility is not a universal rule of sugar beet growing. As far as phosphoric acid is concerned, there would seem to be very little danger of loss, since even the farms which used artificials only are seen to have given the soil three times as much of this substance as the crop took out. Nevertheless, in the case of the losses of nitrogen due to the crop, as opposed to those due to drainage, the favourable result is seen to depend on the use of dung. Thus, whereas the farms using farmyard manure show a very safe margin in this respect, those farms where artificials only were applied incurring a small loss, *viz.*, of 12 lb. per acre, an amount representing approximately 0·5 cwt. of sulphate of ammonia. Potash also shows a loss of 13 lb. per acre on the second group, and, as in the case of nitrogen, there is

a considerable gain in the first group. Unlike the case of nitrogen, however, this gain does not depend on the use of farmyard manure, since it is shown that, had no farmyard manure been used, there would still have been a small gain of potash, *viz.*, of 8 lb. per acre, and potash may, therefore, be regarded as about level. There is no reason to suppose that any heavier manuring was practised here than would be used in general, so that on the whole there would seem to be little risk of soil impoverishment. It should be borne in mind, however, first that sugar beet takes a heavy toll of potash, and, secondly, that when farmyard manure is not applied to this crop generous doses of nitrogenous fertilizers would seem to be desirable.

"ASH" OF CANE SUGARS. **J. W. Schlegel and A. Weber.** *Facts about Sugar*, 1926, **21**, No. 46, 1090-1092. Following analysis represents the average composition of the mineral matter of raw cane sugars from 18 sources, representing 69 per cent. of the world's production of cane sugar: K_2O, 32·35; Na_2O, 2·03; CaO, 15·94; MgO, 4·37; Fe_2O_3 and Al_2O_3, 3·23; SiO_2, 6·58; P_2O_5, 3·89; SO_3, 10·19; Cl, 2·82 and CO_2, 19·42 per cent. Numerous analyses are given of the mineral matters of centrifugal, muscovado and molasses sugar of various origin.—GLUTOSE IN CANE MOLASSES. **H. J. Waterman and W. A. van der Ent.** *Archief*, 1926, **34**, No. 35, 942-948. Glutose (the unfermentable sugar present in cane molasses that reduces Fehling's solution) appears to be formed during manufacture by the action of lime on the levulose of reducing sugars. Practically none is formed as the result of the De Haan modification of the carbonation process (simultaneous liming and carbonating), nor during evaporation. It is present in Java molasses to the extent of 6-7 per cent., and in Cuban it may be higher, about 10 per cent. Presence of this sugar explains the low yields in cane distilleries sometimes reported.—ADSORPTION (DECOLORIZING) CARBONS AND THE SUGAR INDUSTRY. **P. Smit.** *Centr. Zuckerind.*, 1926, **34**, No. 39, 993-994. Author (formerly interested in manufacture of "Purit") admits that the ideal is a cheap carbon of great adsorption power not requiring to be regenerated, but this not being available one must regenerate. A good type of regenerating oven for powders is described by LUNGE and KÖHLER, which operates excellently.[1]—VISCOSITY OF PECTIN SOLS. **Asta Ohn.** *Industrial and Engineering Chemistry*, 1926, **18**, No. 12, 1295-1298. Using a pectin preparation made from orange peel, the optimum ratio for a good jelly is 0·4 grm. pectin and 62·5 grms. of sugar per 100 c.c. at *pH* 2·6, the relative viscosity of this sol being 0·56 at 103° C. Temperature at which the sol shows a sudden increase of the relative viscosity may be called its "jellying point," so that measurements of the relative viscosity may be used as an indication of the jellying power.—ELECTRIC LIME KILNS. **F. J. J. van der Kolk.** *Archief*, 1926, **34**, No. 42, 1201-1213. Limestone can be burnt in electric furnaces, consisting of rotating drums (somewhat of the form of a dryer) heated by electrodes placed horizontally, the carbon dioxide formed being pumped out of the apparatus. Owing to the reduced pressure inside the drum, decomposition is effected at 650° in place of 850° C., and the gas has a content of about 98 instead of 25-30 per cent. Yields of 50 per cent. of CaO and of 40 per cent. of CO_2 are thus obtained. No coke is used.—EFFICIENCY OF CLARIFICATION. **H. J. H. van der Linde.** *Archief*, 1926, 34, No. 13, 350-351. This is expressed by: Weight of precipitated non-sugars/weight of non-sugars in the raw juice × 100, which may be elaborated to: $E = \dfrac{100\,\dfrac{(RQ\,dns - RQ\,rs)}{RQ\,dns}}{100 - RQ\,rs} \times 100$ per cent., in which *RQ dns* and *RQ rs* are respectively the purities of the raw and clarified juices. Applying this formula, the following values for the "efficiency" are obtained for three types of factories in Java:—

	RQ rs	*RQ dns*	*RQ dns* — *RQ rs*	*E* Per cent.
Nieuw Tersana (Def.)	79·0	80·0	1·0	5·95
Demak Idjo (Sulf.)	87·1	88·0	0·9	7·93
Tandjong Tirto (Carb.)	85·0	87·5	2·5	19·05

J. P. O.

[1] "Steinkohlenteer u. Ammoniak," II (5 Auflage; Seite 62).

Review of Recent Patents.[1]

UNITED STATES.

Clarification of Sugar Solutions (e.g., Molasses). **Keiichi Seo,** of Kanagawa-Ken, Japan. 1,609,133. December 14th, 1926.

"In the case of the sugar solution being molasses, use it as it is, or if it is too thick, add water to a suitable degree. Cane and beet juice are used as they are or mixed with any metallic hydroxides except alkali-metals. Starch solutions producing by saccharifying impure starch with acid and "ame" may be used as they are. Add to the sugar solution a fifth part or an equal quantity of a solvent immiscible with water and lighter than it (naphtha, petroleum, benzine, benzene, petroleum ether, or the like). After shaking and stirring the mixture violently, allow the same to stand; until the colloidal substance rises to the surface of water solution in a gel-form. In this process almost all the metallic compounds contained in the solution (except any alkalimetals) combine with the colloidal substance and float up to the surface of the water solution. Any objectionable odour of fatty oil, resin and alkaloid, can be removed by dissolving in the solvent and then settling or decanting them. However, if it is impossible to remove the impure matters entirely by the above method, use the solvent together with water-soluble metallic compounds except alkali metals (mostly salts of the calcium are used), or add the solvent to the sugar solution after acidifying the latter with inorganic or organic acid, and after shaking and stirring violently, allow it to settle until the impure matters rise to the surface of the solution in a gel-form or are dissolved in the solvent. In this process, the metallic compound combines with the colloidal substances chemically, so that its quantity must be equivalent to the impurity contained in sugar solution. The impure matters thus separated are removed by means of decantation or filtration. The quantity and kind of the chemicals used in removing the impure matters differ according to the nature of the solution and of the product to be manufactured. The remaining chemicals are removed by evaporation or precipitation by proper means. By this simple method all impure matters can be almost entirely removed from sugar solution. Molasses so treated loses its odour and becomes palatable, and its sugar content is increased by 20 to 36 per cent. In impure starch solution and "ame" thereof, the quality of manufactures is improved, and goods of superior quality may be made out of such impure starch."

Method of manufacturing Sugar (the Juices being clarified in Centrifugal Separators). **Albert P. Leonard,** of New York, U.S.A. Re-issue 16,511; original, 1,568,512. Re-issued, December 28th, 1926; original dated January 5th, 1925.

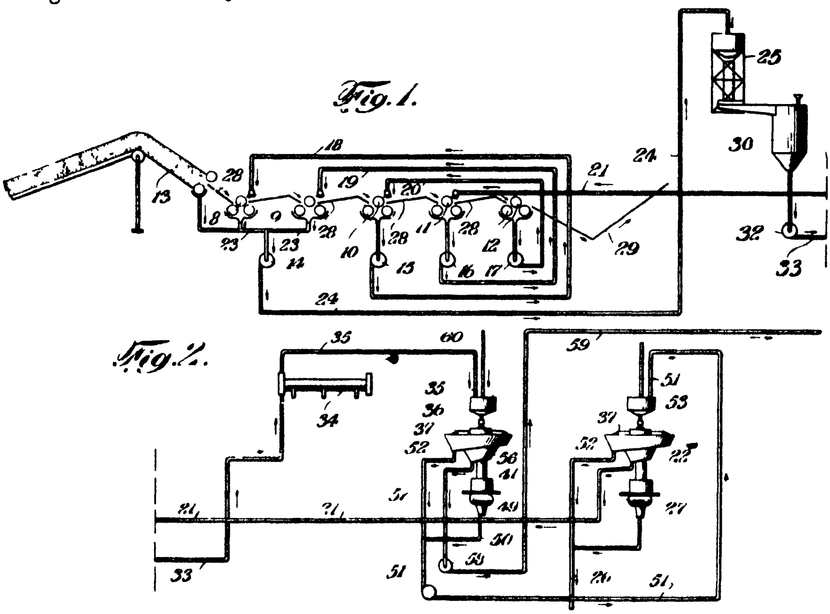
As indicated in Figs. 1 and 2 the cane is transported successively to the mills 8, 9, 10, 11 and 12 from a conveyor 13, where it is repeatedly crushed and macerated. The mills deliver the expressed raw and mixed or dilute juice to return juice pumps 15, 16 and 17; and ultimately all of the raw and mixed or dilute juice to the pump 14 alone, the product of the said mills being rendered as a syrup by water and the mixed or diluted syrup delivered thereto by the pipes 18, 19, 20 and 21, the last of which pipes delivers a clarified juice or water slightly saccharine, the latter product being a portion of the juice or syrup delivered from the pump 14 to and through a weigher mechanism 25 and a clarifier or liming tank 30 to the separator and from the clear juice hoppers thereof. Mills 9 and 10 (of the usual 3-roller type), are supplied with a macerating medium consisting of water or preferably the juice extracted by the mills 10 and 11, while the mixed juice from the mills 8 and 9 is conveyed by the pipes 23 to the pump 14, to be delivered therefrom by means of the pipes 24 to the juice-weigher 25. The juices which are delivered from the mills 10 and 11 are mixed not only with the juices of the mill 12, but also the clear juice from the last separator and from the clear juice hopper 22 thereof by way of the pipe 21.

[1] Copies of specifications of patents with their drawings can be obtained on application to the following—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C. 2 (price 1s. each). Abstracts of United Kingdom patents marked in our Review with a star (*) are reproduced from the *Illustrated Official Journal (Patents)*, with the permission of the Controller of H.M. Stationery Office, London. Sometimes only the drawing or drawings are so reproduced. *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille, du Temple, Paris. *Germany:* Patentamt, Berlin, Germany.

The dilute sugar solution delivered by the pipe 21, after passing through the mill 12 is transferred by the pump 17 to the mill 11 where it re-enters the circulatory system and is eventually conveyed by the pipe 24 to the juice-weigher 25. Thus it will be seen that in the present method the only waste product which is finally disposed of is passed by the pipe 26 from the mud and scum outlets 52 and 27 of the last or final centrifugal separator with which the manufacturing system is provided. As the juice passes the weigher, it is delivered to the liming tank 30, where it is treated with a small percentage of lime which performs the customary clarification when heated. The milk-of-lime may be introduced through the funnel 31, and pipe connected therewith, which conveys it near to the bottom of the liming tank. From the liming tank the juice is forced by the pump 32 and the pipe 33 connected therewith through the heater 34, after which the juices are conveyed by the pipe 35 to the hopper 36 of a centrifugal rotary separator 37. As shown best in Fig. 3, the separator 37 consists primarily of a double pointed elongated tubular chamber, the delivery ends 38 whereof are contracted, forming the laterally extending apex of conical ends 39 of the separator. The openings in the ends 38 are normally open, but are provided with valves 40 by which their degree of opening may be regulated. The tubular chamber of the separator 37 is mounted on the tubular shaft 41, into which flows the scum contained in the liquid which is delivered from the hopper 36 by way of the pivotally connected pipes 42 and 43. The pipes 42 and 43 are connected by a gland packing 44. The pipe 43 is rigidly connected with distributing extensions 45, by which the juices are delivered to the separator 37, at a point

Fig. 1.

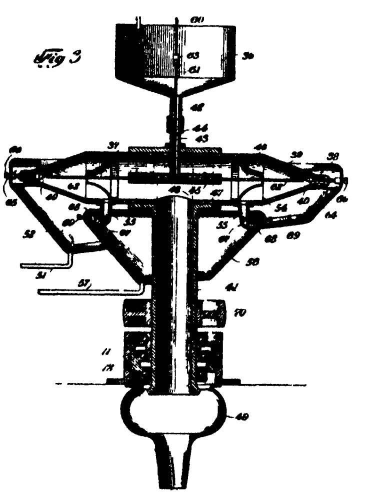
Fig. 2.



removed from the shaft 41. As the rotating element consisting of the separator 37, shaft 41, and extensions 45 is rapidly rotated, the liquid contained therein has imparted thereto a centrifugal effect, so that, on leaving the extensions 45, the heavier materials contained in the liquid are immediately carried towards the frusto-conical baffles 46. It is obvious that when the crude liquor is delivered from the extensions 45 at the rear of the baffles 46, the material separates on the lines of their specific gravity, so that the scum and lighter particles will occupy the region between the lines 47 and 48. The lines 48 are coincident with the inside surface of the tubular shaft 41, so that as the lighter material, being less affected by the centrifugal operation of the apparatus, and by the approach to the centre of rotation thereof, flows into the shaft 41, to be carried thereby to the outlet hopper

49, from whence it is carried (Fig. 2) by means of the pipe 50, to the refuse pipe 51, through which the deposits in the hopper 52 are conveyed to the hopper 53 of the next succeeding separator. When the heavier products pass through the somewhat constricted openings in the baffles 46, they pass into the conical ends 39, where again separation between the lighter and heavier products takes place. The lighter product, which in this region is the clear juice, is forced backward under the overhang of the baffles 46, into the space 54, from which lead down the pipes 55. The pipes 55 are normally opened so that the juices deposited therein may flow into the hopper 56, from which the accumulated juice is carried by the delivery pipe 57, through the pump 58, and the pipe 59, to other apparatus, where concentration, crystallization, and separation of sugar is carried on. When the separator herein disclosed is fully functioning, the mud suspended in the liquid is separated therefrom and delivered to the contracted ends 38 of the separator 37. To supply the necessary liquid for operation of the system, water is delivered thereto by circulating pipes 60 and 61 and lateral extensions 62 thereof. The stationary pipe 60 and rotary pipe 61 are suitably connected by the gland packing 63 (Fig. 3). The delivery ends of the lateral extensions 62 are juxtaposed to the conical heads of the valves 40, so that water delivered by the said pipe flows around the said valves, and forms a clearing stream through the openings in the ends 38, thus preventing the damming of the openings through the said ends by the accumulation of heavy matter. It becomes expedient at times to regulate the flow through the ends 38. To this end the valves 40 are held from seating by annular bands 64. The bands 64 are suitably supported on adjusting screws 65, the heads 66 whereof extend beyond the wall of the hopper 52, to be manipulated by the attendant to contract or expand the band 64, and thereby move the valves 40 further from, or permit them to move nearer to, their seats, to vary the delivery openings in the ends 38. A similar construction is provided for regulating the seating of the valves 67, which control the delivery openings of the down pipes 55. This control is exercised by contracting and expanding the bands 68 by means of the set screws 69. It is obvious that if the flow of the clear juice from the down pipe 55 is too great to permit the liquid to remain in the ends 39, and in the spaces 54 sufficiently long to properly separate, the flow from the said down pipes is retarded by adjusting the bands 68, and the valves 67 operated thereby. Likewise, if the flow from the ends 38 is too great to permit the proper separation, this is regulated by means of the screws 66 and the band 64. The separator 37 and the tubular shaft 41 connected therewith are rotated very rapidly, employing for this purpose any suitable means, that shown in the present drawings being the belt pulley 70, which is operatively connected with any suitable prime mover by means of a belt. It will be understood that the pulley 70 and parts connected therewith may be substituted by any other form of driving mechanism, such as an independent electric motor. The standard 41 is supported in service by any suitable bearing, such as the pedestal 71, and the ball races 72, mounted thereon. By reference to the schematic view shown in Figs. 1 and 2, it will be seen that the mud separated from the clear juice delivered to the hopper 52 in the first separator 37 passes by means of the pipe 51 to the receiving hopper 53 of the second separator 37. It will also be understood that the performance of the second separator and parts connected therewith is exactly the same as that above described with regard to the first separator, the principal difference in the result being due to the fact that the liquor furnished to the second separator has been largely denuded of all saccharine matter. A further difference in the utilization of the second separator

Fig. 3

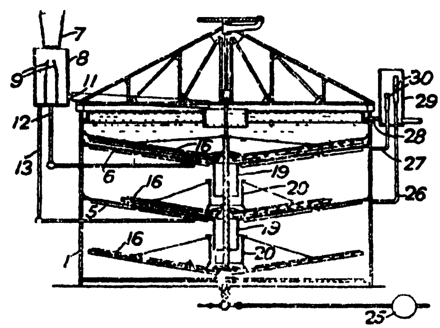


is to found in that the hopper 22 of the second separator, which corresponds to the hopper 56 of the first separator, delivers the clear juice thereof, which is slightly saccharine, to the pipe 21, through which it is carried back to the mill 12 to furnish the necessary liquid therefor, which as above stated, is transferred therefrom with the richer product by way of the pumps 17 and pipe 20, to the mill 11, and again carried through the remainder of the milling process and clarification plant. It will also be observed that the refuse delivered by the second separator to its hopper 52, is conveyed by the pipe 26 to the refuse pound or dump, for use as fertilizer or treated in any other suitable manner.

Improvements in the Destructive Distillation of Vinasse (Distillery Slops). **Gaston P. Guignard,** deceased, late of Melun, France. 1,609,712. December 7th, 1926. A process for the destructive distillation of vinasse under vacuum and in the presence of moisture, comprises gradually and continuously introducing moisture, during the entire period of the destructive distillation, into the heart of the mass being distilled, and continuously agitating the mass, during distillation at a temperature of about 450 to 650° C.—Production of Anhydrous Hydrosulphites. **Lloyd K. Riggs** (assignor to **E. R. Squibb & Sons,** of New York). 1,609,773. December 7th, 1926. This method comprises heating crystalline hydrosulphite in an atmosphere of water vapour to a temperature sufficiently high to release the water of crystallization and withdrawing the water and water vapour while maintaining the temperature of the anhydrous product at a point which precludes recombination of the water therewith.—Evaporation Process. **Walter L. Badger,** of Ann Harbor, Mich. (assignor to **Swenson Evaporator Co.,** of Chicago, Ill., U.S.A.). 1,609,853. December 7th, 1926. A process of evaporation which utilizes seed crystals to facilitate crystallization and includes boiling the treated liquid in an evaporator, and introducing into the evaporator relatively small quantities of the treated liquid in a saturated condition and at a temperature above the temperature of the boiling liquid in the evaporator whereby the superheated liquid flashes upon entering the evaporator to form the seed crystals utilized to promote crystallization of the liquid.—Manufacture of Fertilizers. **Edward L. Pease and Daniel Tyrer,** of Stockton-on-Tees. 1,610,109. December 7th, 1926. Fertilizer is made by causing sulphuric acid to react with calcium phosphate to form calcium sulphate and phosphoric acid and then treating the calcium sulphate, while it still contains phosphoric acid, with ammonium carbonate so as to produce ammonium sulphate and calcium carbonate containing phosphate.—Use of Bagasse Pith for Making Explosives. **Wendell R. Swint** (assignor to **E. I. Du Pont de Nemours & Co.,** of Wilmington, Del., U.S.A.). 1,609,221. November 30th, 1926. A non-gelatinized explosive composition contains a normally liquid high explosive, ammonium nitrate, and sufficient bagasse pith to substantially reduce the density of said composition.—*pH* Testing Apparatus. **Emery W. Todd,** of Mitchell, Nebr., U.S.A. 1,601,383. September 28th, 1926. "Testing apparatus comprises a primary cell having electrodes reversely affected by acid or alkali electrolytes and a galvanometer across the terminals of the cell graduated in terms of acidity and alkalinity." An indicator is provided graduated in degrees of alkalinity and acidity, a change in reaction thus causing the needle to swing from degrees alkali to degrees acid, or conversely.—Syrup Pump. **Edwin T. McCall,** of Laurinburg, N.C., U.S.A. 1,611,601. December 21st, 1926. Claim is made here for an apparatus for lifting syrups, comprising in combination : A receptacle having a well at the bottom thereof, a hollow member mounted for vertical movement within the receptacle, a piston operating in the well and having a central opening, said piston including an upper movable section having a reduced portion extending into the opening, a flange at one end of the reduced portion, and adapted to engage the piston to movably connect the piston and upper section, said upper section having shoulders adapted to engage the piston to force the piston downwardly, said upper section having a valve seat, and having a bore to permit the passage of fluid therethrough, a vertically movable valve adapted to co-operate with the valve seat to restrict the passage of fluid through the hollow member, said valve adapted to move vertically on downward movement of the hollow member to permit fluid to pass upwardly through the hollow member.

UNITED KINGDOM.

SETTLING APPARATUS. **Dorr Company,** of 247, Park Avenue, New York, U.S.A. (assignors of **W. C. Weber,** of Larchmont, New York). 262,479. December 6th, 1926; convention date, December 6th, 1925. A settling-vessel 1 is divided into compartments by trays 5, 6 with central depending cylinders 19 for the discharge of the settled matter, which forms a continuous column from the top compartment to the bottom of the tank, whence it is withdrawn by a pump 25. Cylindrical baffles 20 attached to and rotating with rakes 16, which move over the trays 5, 6, prevent the admixture of unsettled liquid with the central column of sludge. The clear liquid passes from the top of the compartments through pipes 26, 27, 28 which lead to an over-flow vessel 29, the upper ends of the pipes 26, 27 being provided with adjustable shields 30 to regulate the flow through the pipes. The material for treatment flowing from a feed trough 7 is directed by adjustable vanes 9 to the compartments of a vessel 8, which are connected to the several compartments of the settling-vessel 1 by pipes 11, 12, 13.—EVAPORATOR. **Blair, Campbell & McLean, Ltd.** of Govan, Glasgow. 262,608. December 30th, 1925.. A single tubular pre-heater or pre-evaporator is used in conjunction with two or more finishing bulk evaporators. A continuous stream of liquor under treatment is maintained by a pump through the tubes of the heater and is discharged through valves into one or the other of the evaporators which are connected through a condenser with a vacuum pump.—PECTIN PREPARATION. **Douglas Pectin Corporation** (assignees of **H. G. Loesch,** of Rochester, New York). 262,736. November 3rd, 1926; convention date, December 10th, 1925. A pectin preparation containing solid pectin suspended in a liquid medium is employed in making jellies and preserves. The pectin, together with a suitable organic acid such as lactic, tartaric, citric, or malic acid, is added to any suitable liquid in which the pectin is insoluble. The liquid is miscible with water and may consist of alcohol or glycerine, or of a syrup prepared from cane sugar, dextrose, invert sugar, or a mixture of sugars, or form sugar-containing fruit juices which are concentrated, or have sufficient sugar added, to form a syrup in which the pectin is insoluble. The acid dissolves in the liquid, and when the preparation is mixed with water for use the pectin readily dissolves without forming lumps.—FOOD FOR ANIMALS UTILIZING MOLASSES, ETC. **A. Bu,** of Stord, Norway. 263,014. April 26th, 1926. A cattle food is prepared by intimately mixing with molasses, herring or other fish, seal or whale-meat, or the waste products thereof. The raw material may first be finely divided and the water content pressed out.—EVAPORATOR. **E. Morterud,** of Torderod, near Moss, Norway. 263,132. December 10th, 1926; convention date, December 19th, 1925. Liquid flows down a series of troughs enclosed in an evaporating chamber and heated by tubes passing upwards through the troughs and supplied with steam from an inlet through central tubes. Exhaust and condensed steam pass through an outlet. Concentrated liquid collecting in the base of the chamber is returned by a pump to the upper trough. The outer surfaces of the tubes are kept clean, by mounting the troughs on a central rod and reciprocating them vertically. The tubes may also be fitted with scrapers.—EVAPORATING AND DISTILLING VINASSE (SPENT DISTILLERY SLOPS). **E. A. Barbet,** of Paris. 263,322. January 30th, 1926. In treating vinasses to distil off glycerine and obtain a dry residue suitable as a fertilizer, the liquid is concentrated until its boiling point is about 125°C., and the heated liquid is subjected to a sudden high vacuum which causes vigorous evaporation, the steam carrying over the glycerine. The liquid is repeatedly heated to successively higher temperatures and subjected to vacuum treatment between each heating.



United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1927. Tons.		1926. Tons.
Total Receipts, January 1st to February 23rd	345,928	..	464,270
Deliveries ,, ,, ...	360,613	..	460,024
Meltings by Refiners ,, ,, ...	332,548	..	444,000
Exports of Refined ,, ,, ...	2,500	..	5,000
Importers' Stocks, February 23rd	100,577	..	12,902
Total Stocks, February 23rd	218,909	..	105,204
	1926.		1925
Total Consumption for twelve months	5,671,335	..	5,510,060

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1925, 1926, AND 1927.

(Tons of 2,240 lbs.)	1925. Tons.		1926. Tons		1927 Tons.
Exports	436,437	..	376,797	..	152,914
Stocks	293,891	..	355,584	..	298,683
	730,328		732,381		451,597
Local Consumption	6,000	..	6 000	..	6,000
Receipts at Ports to January 31st	736,328		738,381		457,597

Havana, January 31st, 1927. J. GUMA. - L. MEJER

Sugar Crops of the World.

(Willett & Gray's Estimates to February 24th, 1927.)

	1926-27. Tons.		1925-26. Tons.		1924-25. Tons.
CANE.					
America	8,369,084	....	8,666,365	....	8,877,329
Asia	6,229,957	....	6,308,484	....	5,661,027
Australasia	510,000	....	592,911	....	536,490
Africa	617,000	....	679,387	....	545,260
Europe..................	7,500	....	9,000	....	8,087
Total Cane.........	15,733,541		16,256,147		15,628,193
BEET.					
Europe..................	6,847,470	....	7,441,441	....	7,083,068
U.S.A....................	810,000	....	804,439	....	974,185
Canada..................	28,000	....	32,475	....	36,200
Total Beet	7,685,470		8,278,355		8,093,453
TOTAL CANE AND BEET..	23,419,011		24,534,502		23,721,646

United Kingdom Monthly Sugar Report.

Our last report was dated the 8th February, 1927.

During the period under review, there has not been much change in prices The markets all over the world have been quiet, and the demand from the trade poor.

The London Terminal Market has continued to be more active than in the corresponding months of last year, and registrations continue in large volume. More interest has been shown in the old crop positions, but speculators are not showing the same inclination towards new crop months. Good quantities of March have been transferred to later months, and about 8000 tons were tendered on the 1st March. These were rapidly absorbed, and made little impression on the market. February was finally liquidated at 18s. 1½d., March fluctuated from 18s. 3d. to 17s. 10½d., to 18s. 5¼. to 18s. 1½d. May was traded in from 18s. 6¾d. to 18s. 2¼d. to 18s. 9d. to 18s. 4½d. August sold from 18s. 9¾d. to 18s. 4½d. to 18s. 10½d. to 18s. 6d. October from 17s. 1½d. to 16s. 10½d. to 17s. to 16s. 9¾d., whilst December moved from 16s. 8¼d. to 16s. 6¾d.

A new feature of the Terminal Market has been the change of the basis from " A " Type to the " B " Type, for all positions from January, 1928, onwards. March 1928 has been traded in from 17s. 11¼d. to 18s. 0¾d. to 17s. 11¼d. The latest prices are March 18s. 2¼d.; May 18s. 5¼d.; August 18s. 7½d.; October 16s. 9d.; December 16s. 3¾d.; and March 1928 (new basis) 17s. 11¼d.

Actual sugar has continued to be dull, and the trade have not at any time shown any desire to buy more than their bare requirements. No sugar has been offering from Czecho-Slovakia, but second-hand parcels continue to come on the market. Ready f.o.b. Hamburg has been sold from 19s. 1½d. to 18s. 10½d., and April/May from 19s. 4½d. to 19s. 1½d. Dutch Granulated has been more plentiful, and sold down to 18s. 9d. for ready, and 19s. 3d. for April/August. American and Canadian Granulated sold from 20s. c.i.f. down to 19s. 7½d. c.i.f. Spot Granulated moved from 31s. 10½d. to 31s. 4½d. to 31s. 9d. to 31s. 7½d., duty paid. Owing to the unsettlement in the Eastern markets, there has been a more plentiful supply of White Javas, and a fair business has been done in July/June shipment to U.K., at 18s. c.i.f.

It has been difficult to sell home grown, and the sugar from one group of factories has been pressing on the market. Ely and Ipswich sold their sugars down to 31s. 6d., at which price they are still sellers to-day. Other factories are either sold out, or are obtaining better prices, and the latest quotations are 31s. 6d. to 32s. 6d. according to the factory. The British refiners prices show little change. On the 11th February they reduced their quotations by 6d. per cwt., but on the 17th February they were advanced again 3d. per cwt. The latest prices are No. 1 Cubes 37s. 3d., London Granulated 32s. 10½d., duty paid.

The value of Raw Sugar has fallen from 15s. 4½d. to 15s. 1½d. c.i.f., and a fairly large business has been done at this latter price, chiefly to the Continent. To-day's price for Cubans is 15s. 3d. c.i.f. for March/April shipment. The British refiners have not been anxious buyers owing to the lack of demand for their Refined.

In New York the demand for Refined has continued disappointing, and in consequence the refiners have only bought sparingly of Raws. Cubans 96 per cent have been sold from 3 3/16 to 3⅛ c.i.f. New York. at which latter price there are buyers over to-day. Porto Ricos and Philippines have also been selling at this parity. The Futures market has closely followed actual sugar, and shows practically no change in quotations since a month ago.

F. O. LICHT has made no further change in his estimate, but with regard to the next crop, although giving no figures, he reports that the sowings will be " somewhat larger " than last year.

With regard to Cuba, the PRESIDENT has now signed a decree allotting to each district and central their respective quotas to make up the crop to 4,500,000 tons. The receipts to date are 1,467,000 tons, against 1,696,000 tons last year, and the stock at the ports is 852,000 tons against 764,000 tons.

21, Mincing Lane,
London, E.C. 3,
8th March, 1927.

ARTHUR B. HODGE,
Sugar Merchants and Brokers.

THE

INTERNATIONAL SUGAR JOURNAL

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No. 340. APRIL, 1927. Vol. XXIX.

Notes and Comments.

The American Sugar Refining Company in 1926.

The annual report for 1926 of the American Sugar Refining Company states that the year was more favourable for refiners than for sugar producers. The slowly rising prices in the second six months afforded opportunity for a better return from refining operations, notwithstanding the inadequate margin prevailing most of the year. In 1926 the Company refined 1,374,350 long tons of raw sugar at a profit of $7,091,978, which compares with 1,307,622 tons and a profit of $4,477,143 in 1925. This is equivalent to about one-fourth of a cent per lb. There was also received during the year income and interest of $2,044,993, including that received from the Company's producing properties in Cuba; this compares with a profit of nearly three million dollars in 1925. No details are however offered this year as to the operations of the Cuban properties.

A feature of these annual reports is invariably the interesting comments on the world sugar situation which the directors of the Company make, though naturally enough the view-point is that of the refiner who wishes to see an ample supply of raw sugar for his operations and a convenient market both at home and overseas for refined sugars. In the present report the influence of governmental interference is dwelt on and criticized. Some students of sugar believe (we are told) that it will be years before there is a return on a purely economic basis to the balanced condition of production and consumption, such as existed throughout the world for many years prior to 1914. The outstanding features which have heretofore affected the situation are: First, the unstable character of the market in its effort to reach a balance after the violent changes incident to interference of various Governments; second, the excess capacity, both of the United States refineries and of Cuban production, called out by the war effort of the United States and of Cuba, but not safeguarded by either Government securing post-war markets. "A third feature has to be added, of more recent development, which promises to be of considerable importance in affecting the industry, namely that of import duties and internal taxes on sugar. By reason of increasing production, various systems of duties and taxes

throughout the world have been set up till at the present time 100 countries out of a tabulated total of 108 have some form of import duties. The rapid erection of these tariff barriers is naturally introducing great confusion in the flow of international trade. The progressive effect on the United States field and more directly on Cuba will most likely become of increasing importance hereafter."

Excess Refining Capacity in the States.

Mr. BABST points out that even as far back as 1915 he called attention to the destructive competitive conditions prevailing in the United States refining industry, due largely to the fact that the refining capacity of the country was greatly in excess of consumption. In 1916 over 700,000 tons of refined was exported and a million tons could have been spared. Since then four competitive refineries have been built and existing ones enlarged. At the present moment the maximum domestic requirements of the U.S.A. from cane sugar refineries, based on the largest consumption, are about five million tons a year, while the capacity of all the refineries based on 300 working days is about 7½ million tons. This gives a surplus of about 50 per cent. in excess of the country's needs.

In Mr. BABST's view, the Cuban producers and the United States refiners are both faced with a like problem of finding employment for their excess capacity. It is desirable for United States consumers that the Cuban crop should be maintained at the present level of five million tons and over, in order to afford ample supplies and fair prices. It is essential to that end that Cuba should receive fair prices ; it is equally essential that the refiners should secure adequate earnings. These ends would be aided and promoted by the adoption by Cuban producers, in co-operation with United States refiners, of a systematic marketing plan to handle part of Cuba's surplus production in export markets. Cuba, says Mr. BABST, continues to face a race for the sugar markets of the world, while the United States refiners are in a position to be of great assistance to Cuba in finding world's markets for her ; in doing so they would also, over a period of years, serve U.S. domestic consumers and be helpful to domestic sugar producers.

This statement of the refining position of the United States leaves one in no doubt that the aim of the big refining interests of that country is to control if they can the supplies of raw sugar from Cuba, and find overseas markets for their surplus refined products to the extent of at least 50 per cent. of their domestic requirements. But, as they realize, the overseas door is tending to be increasingly barred by tariffs and the British market (while it remains on its present fiscal basis) and the Far East would appear to present the only profitable dumping grounds for the surplus of American refineries. The former is already well cognizant of this American competition which has been one factor among several that led to the recent temporary closing of certain London refineries ; and intelligent anticipation credits the new Budget which is unfolded to Parliament while we go to press (too late for us to give details in this issue) with an intention to levy extra taxation on foreign refined sugar. The British refiners have recently made representations to the Government on this score. But it may be observed that of late their worst competition has come from Czecho-Slovakian sugars which are being dumped over here at a price which can show little or no profit on the cost of production. The record of Greenock, given below, is a case in point.

Notes and Comments.

The Greenock Refining Industry.

In the annual report of the Greenock Chamber of Commerce for 1926 the declining fortunes of the local sugar refining industry are referred to, and it is pointed out that the quantity of sugar dealt with during the past year, viz., 108,750 tons, has been the smallest tonnage of any year since 1862, being even worse than that of 1899 when the competition of bounty-fed Continental refined was at its worst. To a large extent this low record was due to the coal stoppage, which completely disorganized the trade; but the competition of both Home beet sugar and foreign refined has steadily had its effect on the Clyde industry. But three refineries remain, while the Orchard factory is engaged on beet sugar production. Competition from America and Canada was not so serious in 1926, but their place as competitors has been more than occupied by Czecho-Slovakia which during the 12 months ending November 30th sent to this country no less than 300,000 tons. " A very careful investigation as to prices has satisfied United Kingdom refiners that for a great part of that period Czecho sugar was selling here at prices which yielded the sellers a return much below that from their home sales, the difference amounting at times to as much as £5 per ton. This competition coming simultaneously with that of the home grown beet and colonial direct consumption sugars is affecting Greenock very seriously."

The Trade Position in Cuba.

Various recent consular reports from Cuba indicate that the improvement in the price of sugar has come none too soon for Cuba's commercial stability, for while it has relieved the situation, the depth of the recent depression in trade has been too great to allow business in general to respond immediately to the improvement. The outlook in trading circles is more optimistic, but there is seemingly no expectation that a rapid revival of business will occur, since the first receipts from the new crop must go to settle outstanding indebtedness, and in fact a good share of the profits of the whole season will go largely for that purpose. However, the opening of the sugar campaign has furnished work for thousands who will now be possessed of the means of spending. But Cuban economists are becoming increasingly alive to the peril of their country's dependence on this one industry, and while manufacturing industrial development is encouraged on patriotic grounds, and is to be fostered by a protective tariff, greater attention to crop development would appear to be best suited to Cuba's climate and her position as an essentially agricultural country.

Meanwhile sugar is selling at about 3 cents a lb., a figure that is much more remunerative. Many merchants in Havana indeed would like the price to go up to 4 cents or over, but the settled view of conservative bankers and business leaders continues to be that such a rise in sugar prices would only tend to stimulate production in other countries, and that a business boom resting on consequent over-production and speculation in sugar would be undesirable. The present steady recovery if maintained will suffice to bring a return of normal profitable business within a few months.

World Exports of Sugar Machinery.

A New York banking institution in its monthly journal recently had an article on the trend of the sugar machinery trade of the world. Five countries supply the bulk of the equipment required, these being, in order of importance, the United States, United Kingdom, Holland, Germany and France. American and French exports in 1925 showed a notable increase

over those of 1913-14, while German exports are still considerably below the pre-war volume. For the United Kingdom and Holland no comparison can be made as the exports of sugar machinery were not separately recorded in the pre-war period.

The largest demand for American sugar machinery comes from North American customers, including Cuba, Dominican Republic, Mexico, Canada, and Central America. South America stands second, almost every country appearing regularly as a purchaser from this source. The insular possessions of the States—Hawaii, Porto Rico and the Philippines—are of course important markets for the American sugar machinery industry. As for future business, Canada where beet sugar cultivation is spreading, Mexico which is extending its cane cultivation in Morelos State, Central and South America, and the West Indies, will all undoubtedly continue to furnish valuable markets for U.S.A. machinery.

British countries and possessions, according to this review, provide the chief outlet for exports of sugar machinery from the United Kingdom. The British West Indies, India, Natal, Mauritius and British Guiana, with the other British possessions, purchased 40 per cent. more machinery of this class in the six years from 1920 to 1925 than did all foreign countries during this period. Java, Argentina, Brazil, Peru, and Portuguese East Africa are the best non-British markets. The chief market for French machinery lies in foreign countries, among which Brazil, Peru and Argentina make the best showing. Germany is said to be making some progress towards recovering its pre-war trade in exports of sugar machinery and apparatus. On the basis of volume the exports of 1925 and 1926 are about one-third of those of 1913. As for Dutch machinery, very little detail is available regarding exports. The great bulk goes, however, to the Dutch East Indies.

Finally, it is pointed out that there is still a large field for development of mechanical appliances in the sugar industry. Hand labour, which is costly in the Western world, is still depended on for digging beets and for much of the work of planting, cultivating and cutting cane. When satisfactory machines are developed for these purposes, a large market will be open to them.

Beet Factory Developments at Home.

A good deal of attention to beet sugar affairs has been given in the provincial and country press of late. The propaganda is being kept well to the fore and the farmers are lacking no excuse for trying the new crop. In some cases indeed the factories have booked up all the roots they can deal with, and have had to refuse further offers to grow them. The Shropshire factory at Wellington seems a certainty for next crop, though it means erecting the building and plant in seven months. It is destined to deal with 700 tons of roots per day and will be a duplicate of the Dyer-built Peterborough factory. A new company, the SHROPSHIRE SUGAR BEET CO., LTD., is taking over the control of the concern from the promoting body, HYGIENIC SUGARS LTD. Work on the Selby factory has been commenced and is to be completed in time for the Autumn campaign. This concern has now been taken over by a Company called the YORKSHIRE SUGAR COMPANY, LTD., which includes on its board Mr. J. N. MOWBRAY of the Peterborough factory, and Mr. W. J. BLANCHARD, a representative of the Dyer Company.

Bardney, Lincolnshire, factory is being strongly supported by surrounding farmers, some 12,000 acres being devoted to beets this year. Cupar

has received enough offers of roots to justify doubling the capacity of the factory for the next season. No further new factories would appear to be projected this year; but it is probable that next year will see a factory in the Chichester or Portsmouth district, as there is a strong desire in that part of the country for one, while growers in the South-west of England are still endeavouring to fix on a suitable locality for a factory in that hitherto untapped part of the country.

"Suchar" Process Developments.

Following the installation of the "Suchar" carbon refining process at Central Mercedita, Porto Rico, and at Illovo, Natal, it is now announced that this method of producing white granulated on the plantation is to be introduced into Cuba, at Central Nazabal, and also into Santo Domingo, at the Central Boca Chica. At the former place the output per day will be 300 tons, and at the latter 125 tons, the product being a very fine grade of granulated, claimed to be at least the equal of the best American sugars.

These developments are certainly interesting, and if continued (and it seems reasonable to suppose that they will be) may in time fundamentally affect the sugar trade of New York, London, and other centres. It may mean that certain countries, now large exporters of raws, may disturb the existing state of things by establishing refining centres here and there, thus becoming producers of granulated of a grade suitable for any market.

The "Suchar" process, which has shown such rapid development since its comparatively recent initiation, and is now commanding serious consideration in different countries, is the result, not of any hurried scheme of process promotion, but of long and careful investigations during a period of twelve years on the part of certain chemists and engineers of high standing. Their method of working, and their special plant, appear to have been tried out with particular thoroughness, and the result of this is shown by the success of the results that have been obtained hitherto under their supervision. What is regarded as a new type of carbon has been evolved, while a very efficient type of automatic filter, and a particularly interesting electric revivifying furnace, are employed. The method of using this material and plant appears simple, and seems to be well adapted to the general conditions of working in tropical countries.

The reasons why sugar at the present time is not refined by its actual producers at the plantation forms a frequent topic of discussion in sugar economics. Lack of pure water, of cheap fuel, and of skilled labour are generally advanced by way of reasons, but these difficulties should be overcome by an efficient carbon process. Moreover such a process combining the manufacture of raw sugar and its refining under one roof reduces overhead expenses, and eliminates charges such as raw sugar bags, packing and transport, loss in weight and loss of polarization in shipment and warehousing, and like costs incidental to the handling and sale of raw sugars. Whether "Suchar" will eventually provide this revolutionary process remains to be seen, but certainly, in the opinion of many technologists who have closely studied its claims, it is likely to make a good bid for success in that direction, and indeed has started well in so doing.

Payment for Beets in Czecho-Slovakia.

According to a Department of Overseas Trade report from Prague an agreement has been reached in the Bohemian beet districts regarding sales of sugar beet for the 1927-28 season; the beet growers have the right to choose either the fixed price, amounting to 18·50 Kc. per 100 kg., or the sliding

price. This latter price will be fixed according to the average price of raw sugar between 1st June, 1927, to 31st January, 1928. If the raw sugar price remains below 175 Kc. per 100 kg. the beet price will amount to 8¾ per cent. of the sugar price. If however the price for raw sugar exceeds 175 Kc. per 100 kg., the beet grower will receive 8¾ per cent. of 175 Kc. plus 11 per cent. of any amount over 175 Kc. The beet growers are guaranteed in the case of sliding prices the minimum price of 15 Kc. per 100 kg. net weight of beet. If the present cartel of raw sugar factories and refineries is prolonged over the 1927-28 season, the beet growers will receive an additional payment for that quantity of beet used in the manufacture of sugar for home consumption.

Sugar Prices in the United Kingdom.

A writer in the *Times Trade Supplement* remarked recently that no foodstuff was sold at a lower margin of profit for the retailer than sugar. Sugar prices are often severely cut by some of the large distributing companies as a bait to the public, and the trade have had to follow suit in self-defence. As a means to combat this, a Retailers' Sugar Association has recently been formed, with the object of securing a farthing per lb. profit for all retailers on all descriptions of sugar. A similar association existed 20 years ago and for five years did useful work for its members. As showing its need, we recollect an instance in those days where a firm of multiple shop grocers sold granulated sugar at one penny per lb. which even at that period was under the cost price. Prices fixed last month by the new Association were as follows : Lump and caster, 4¼d. per lb. ; granulated, 3¾d. per lb. ; and yellow crystals, 3½d. per lb.

Among new companies recently formed are : (1) Yorkshire Sugar Co., Ltd., 8, Frederick's Place, E.C.2. (219,984). Public. Objects : To enter into an agreement with the Selby Sugar Co., Ltd., for the purchase of certain lands, contracts and options, and the benefit of negotiations, and with Sir Robt. McAlpine and Sons, for the construction of a sugar factory. Nominal capital, £275,000 in £1 shares. (2) West of England Beet Sugar Co., Ltd., Sardinia House, Kingsway, W.C. (220,093.) Private. Nominal capital, £1000 in 950 preferred ordinary shares of £1 and 1000 deferred ordinary shares of 1s.

The Canadian Government has issued a Circular in respect of the tare and draft on packages of imported sugar, cancelling Order in Council P.C. 2063 of 1886, and establishing the following : "In the weighing and taring of imported sugars, it is ordered that the allowance to be made for tare and draft upon packages containing sugar imported into Canada shall be the actual weight of such packages as ascertained by weighing same after the sugar is discharged at the port of destination in Canada at the time when such sugar is entered at Customs, the weighing to be performed by Customs-Excise Officers and the labour required in handling and weighing to be furnished by the importer."

OSWALD SCHREINER and PAUL R. DAWSON[1] have obtained noteworthy results on the value of manganese in soils. A highly calcareous soil occurring in Florida employed for the growing of tomatoes, failed to produce a crop, even with heavy applications of inorganic fertilizers, unless stable manure was applied to the young plants. In experiments on this soil striking results were obtained by the application of 25 to 50 parts per million of manganese sulphate in addition to a balanced inorganic fertilizer. In controlled greenhouse experiments normal, vigorous growth and fruiting of tomato plants took place with manganese-treated soil ; whereas under the same conditions, but in the absence of manganese, the plants were greatly retarded in growth, failed to blossom, and developed a strikingly characteristic chlorosis, which, however, rapidly disappeared upon subsequent application of manganese. Experiments under field conditions led to equally marked increase in growth and the commercial yield of fruit.

[1] *Industrial and Engineering Chemistry*, 1927, 19, No. 3, 400-404.

Fifty Years Ago.

Some Australian Sugar Problems.

In the *Sugar Cane* of March, 1877, a Queensland Trade Commissioner of that day is quoted as discussing in a Brisbane paper the problem of facilitating the continuous employment of the machinery engaged in production, for instance in the sugar industry. He pointed out that the sugar season lasted but three to four months of the year, so for the remaining eight or nine months the capital sunk in machinery earned no interest. In solitary instances saw mills were added to the plant in Queensland but were not particularly remunerative. "It is evident (he went on to state) that, in order to utilize to the utmost the expensive establishments of the sugar manufacturers, another industry must be added to that of sugar making. The manufacture of arrowroot has been successfully entered into by one planter whose sugar machinery is thus partially utilized; but something is required which shall afford employment to the entire sugar establishment. This is to be found in the manufacture of beetroot sugar, and for this industry our facilities are even greater than those of France. The soil and climate of Queensland are eminently suited to the growth of the white sugar beet, and the mills require no alteration beyond the substitution of pulpers for rollers. Mr. Strachan . . . . has imported a quantity of seed of the sugar beet from France, and has distributed portions of it to about fifty farmers in his neighbourhood. We hope that this may prove the germ of a gigantic industry in these colonies, and one which will possess the advantage of giving full employment to machinery which now lies idle during two-thirds of the year."

Unfortunately for this confident forecast, nothing would appear to have come of these Queensland beet experiments, and not only has the non-feasibility of beet sugar cultivation in that State been all along manifest, but, as subsequent history has shown, even in the more temperate climes of the Australian Commonwealth beet sugar production has never caught on. Ten or fifteen years later than the above cultivation experiment a beet sugar factory was actually erected at Rosstown, near Melbourne[1] and an attempt was also made to produce beet sugar in the western district of the State of Victoria; but both these enterprises proved unsuccessful. However as the result of Government encouragement and financial aid the Maffra factory in Victoria was erected in 1898. True, it only ran for two seasons ere having to close down, and then remained idle for ten years. But in 1910 it was re-opened under Government auspices, and has continued to work ever since. It remains, however, the solitary instance of a beet sugar industry in the Commonwealth, and its results if not unremunerative have offered no incentive to private enterprise to extend the industry.

The problem of utilizing sugar factories to work other products in the slack season is, it is clear from the above account, a fairly old one. But no concrete proposals have to this day been put forward that warrant investigation, so far as cane sugar factories are concerned.

Mr. P. Honig, formerly research chemist of the General Norit Company, Ltd., Amsterdam, and author of several particularly useful papers,[2] has recently accepted the position as Director of the Chemical Department of the Experiment Station of the Java Sugar Industry, Pasoerean, Java.

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[1] *Concerning Sugar.* [2] *I.S.J.*, 1926, 223, 302, 562, 677.

Sugar Cane Work in Queensland.[1]

In last year's review of the Annual Report on the experimental work in the sugar cane fields in Queensland, the summary of progress in the industry, with which the Director, Mr. H. T. Easterby, usually opens, was briefly explained and commented on.[2] This year he gives the final figure of the new record in production forecasted, and it is surprisingly close to the estimated 484,000 tons, being in fact only some 1600 tons in excess of that amount. One or two points may be added to last year's review in these pages. Firstly, the proportional production of sugar in the (older) southern and (new) northern zones, with Townsville as the dividing line, has been reversed. For last year's crop, the figures were 268,830 tons in the south and 216,755 in the north; this year's estimate gives 164,000 and 226,000 respectively. But this does not necessarily point to the final ascendancy of the growing northern region, with its fine new mills; for in 1923, 1919 and 1916 the north produced the larger crop; and, as the figures for each and every year are not given prior to 1922, other cases may have occurred. These variations are, to all appearance, capable of a simple explanation, namely, that in a year of short rain, like the present, the growth of the cane is seriously affected in the south, whereas, in the north with its rather excessive average, a decrease of rainfall is really of advantage.

The great crop of 485,585 tons of sugar in Queensland last year was, owing to the peculiar local conditions of the industry, of course, a decided disadvantage, in that the amount produced was considerably beyond that required by the Commonwealth, and the surplus had to be sold outside Australia at world's prices, which were very low. Easterby calculates that only 56 per cent. of the crop was used in the country; that received the agreed sum of about £26 per ton, while the rest, sold outside, was only valued at a little over £11. Thus, the sugar industry received only £19 10s. 7d. per ton for its sugar. Naturally, this matter has received a good deal of attention; it is obvious that such a record crop is the last thing that the planters, who are mainly responsible, would desire. Presumably they have to bear the bulk of the burden and, being often without capital, are less able to bear it; they must get a good deal less for their canes than they would be led to expect, from the price fixed by the Government for the three years. Various suggestions have been made, including the limitation of the quantity of sugar to be produced by each factory. But evidently another crisis is in the offing, for similar crops may now be looked upon as a certainty in years of ordinary good weather because of the greatly increased area under cane. It is somewhat of a relief to all concerned that there is every prospect that this year's total will be some 100,000 tons lower than that of last season: but is not this rather unusual? It has been noted that the recurring dry years hit the southern farmers hardest, although this does not seem to be altogether equitable. However, it will, in the long run, all tend to remove the industry more into the northern region with its tropical climate—more suitable for cane growing, but unsuited in many respects to white or at any rate Nordic settlement.

The project of decreasing the areas cultivated on the farms, and yet obtaining the same amount of cane by better cultivation, with the special object of diminishing the heavy labour bill, was mentioned in the last year's review. There is no evidence that this is being done; the Director

[1] Annual Report of the Bureau of Sugar Experiment Stations, Queensland, up to November, 1926. H. T. Easterby.

[2] *I.S.J.*, 1926, pp. 143-145.

points out that, in the period 1920 to 1925, the acreage under cane increased by 65 per cent., while the number of farmers with over five acres increased by 70 per cent. Possibly the larger farmers will have the means to give the improved cultivation that is so much to be desired. But there is yet another line of improvement, which has often been urged in late years, namely, a better use of by-products in the mills. Every encouragement has been offered by the Government towards the establishment of a power alcohol industry; and we note that this has been commenced "on a promising scale." The outturn of molasses for 1925 was about 18 million gallons; two-thirds of this is already utilized, but the remainder is run to waste. A distillation plant has, it is stated, been erected at Plane Creek Mill, Mackay; and it is proposed to use molasses here, as well as planting cassava or manioc; it is estimated that molasses will yield 65 gallons of power alcohol per ton, while the cassava roots will produce 39 gallons. The operations at the factory are expected to commence this month.

Division of Entomology.

There are, as usual, many other items of interest in this long report; and we turn naturally to plantation work, of which the most important projects are the fight which is being waged against insect pests and, more recently, the offensive against fungus diseases. Brief reports on these subjects are included in that of the Director. The Division of Entomology has had a very busy year; the chief point of interest being a new departure, in the erection of an Entomological Laboratory at Bundaberg, to deal with the pests in the southern half of the cane zone, that is, with Mackay as the dividing line. In this new zone 370 farms were visited, and this inspection constituted the chief part of the year's activities; here, as in the north, the white grub is found to be unquestionably the worst offender. There is of course considerable regional variation in the grubs and other insects attacking the cane in the south as compared with the north; and much is being done in breeding these out, to follow their life histories. Besides the various "grubs," the other insects at present receiving attention include the moth borer (*Phragmatiphila truncata*), weevil borer (*Rhabdocnemis obscurus*), and various wireworms and plant eating beetles. Experiments are also being commenced in the control of white grub, on the assumption that its life history is similar to that already worked out for the northern region.

In the northern part of the cane tract, the experimental work at Meringa, the headquarters of E. Jarvis, the Entomologist, was chiefly concerned with testing the efficacy of seven insecticides as fumigants against the white grub. The comparative results, however, are reported to have been greatly affected by the prolonged dryness of the soil, and cannot be regarded as indicative of the best results obtainable. An interesting story is developed in this report of the climatological control of white grub, the action of natural causes, independently of any action on the part of the entomological officers, during the past few years. The last severe outbreak of this pest occurred in 1921, and since that date it has been held in check largely by the weather. To all appearance, the most vulnerable phase in the life history of the white grub (*Lepidoderma albohirtum*), is when it is lying inert in its pupal chamber deep in the ground, and gradually changing from the grub to the full grown beetle. Here, it is true, it is secure from all predacious insects and other enemies; but to reach the proper depth the soil must be soft and, when the change has occurred, if the ground above it is hard, the beetle may find itself a prisoner inside a lethal chamber; it is a long way to the air above,

and its burrowing powers are not sufficient if the soil is not moistened. Everyone who has worked in the tropics will recall the great flights of insects after the first rains, following a period of drought.

Anything below the normal average rainfall, to which the insect development has so nicely adjusted itself, will have its effect; and this is well seen in the analysis of the deficiencies during the last five years. The northern tract, where the white grub is so serious in its depredations in some years, is again favoured by a certain amount of drought. It is important for the insect that the period from June to October, during which it is pupating, should have its normal rainfall, so that the soil may be kept more or less soft. If the rainfall is deficient during this time of the year, and especially when this has also been the case in the earlier part, the grubs may not reach the required depth and the normal changes in their development may not take place. But if the dry period lasts during November and December a still worse thing happens, and multitudes of completely formed beetles are destroyed in their burrows.

In 1921, there was no deficiency, but the rainfall was 34·50 ins. above the average. But in 1922 there was a shortage of 25·30 ins.; 7·52 of which occurred between June and October, and no less than 10·85 during November and December. In 1923 a second blow was struck, with a rainfall 47·19 ins. below the average, and only 2·75 ins. in June to October, in place of the normal 9·87: the numbers of white grub in the fields were "reduced to comparatively harmless proportions." The next year was favourable to the pest, the shortage in the earlier period being only 1·65 ins. But this availed little, because, in 1925, there was another shortage of 21·67 ins., 5 ins. of this deficiency being in the earlier period and, worse still, 6·94 during November and December. Details of the rainfalls at different parts of the year are given in a Table, from 1921 to 1925, the critical shortages being indicated in italics. Each year, excepting 1921 and 1924, shows two figures in italics. It is recorded, further, that from January to August, 1926, the rainfall was 32·58 ins. below the average for this period. Such conditions cannot prevail for ever, and it is well that the entomologists are working hard at perfecting their defensive apparatus, so as to be ready when normal rainfalls are again the rule.

A serious outbreak of "army worm" (*Laphygma exempta*) was recorded during the year, by certain farmers at Highleigh and Edmonton, the areas affected varying from 3 to 20 acres of cane. In one instance it was observed that the caterpillars ate down to ground level a field of 20 acres of young corn in a day. The day following the first seven rows of the adjoining sugar cane were very badly damaged, although the larvae were but half grown, so that the greatest amount of damage was still to come. In another direction, after destroying the corn, they had to cross a road, from which every vestige of grass was removed, "and the larvae were pouring into the cane in numbers so great that it was impossible to walk without destroying probably as many as fifty at each step." Satisfactory control was obtained by spraying a few clean rows of cane in front of the advancing army, with lead arsenate (2 lbs. in 50 gallons of water).

INVESTIGATION INTO DISEASES.

The interesting development in the study of the diseases of the cane fields of Queensland was adverted to in the May[1] number of the *International Sugar Journal* of last year; and a glance at the account of leaf-scald given

[1] *I.S.J.*, 1926, 264.

last month will convince any reader of the importance of this move, which, once started, is being followed up with extraordinary vigour.[1] The formation of the staff is proceeding along excellent lines and, both to give them all-round experience and at the same time to keep things going, a series of exchanges of officers in training has been started. The first step was to get some idea as to the range and severity of the infection by the known fungus diseases. COTTRELL-DORMER, a former entomological assistant, continued in charge until March, 1926, when he entered the University for further training. Then N. L. KELLY, a cadet student of the Bureau at the University, took his place, after having spent some months with D. S. NORTH, the Pathologist of the Colonial Sugar Refining Company, and then gone the round with DORMER. It is proposed that next year KELLY will resume his studies at the University, being relieved by another cadet student. "It is hoped that, in 1928, the Pathological Division will be fully established, with laboratory and staff, since by that time ARTHUR BELL, who is a pathological student travelling abroad, should be back, and graduates of the Queensland University should also be available." The Report on the Investigation of Cane Diseases made during the past year, written by KELLY, is included in that of the Director.

Since March, 1926, 687 farms have been visited, and the results of this prolonged inspection are shown, as last year, in tabular form. In this Table the distribution of Fiji disease, gumming, leaf-scald, leaf stripe (*Sclerospora*), and mosaic is recorded on the farms visited. The Table is merely a summary, and gives the number of farms on which each disease was detected, throughout thirteen districts, presumably arranged more or less from south to north in the cane tract. Thus it is seen that mosaic was found in all but three districts, gumming in eight, leaf-scald in four, leaf stripe in three and Fiji disease in two. The number of farms infected by each disease gives some idea of the extent of any particular disease in each locality. It is carefully pointed out, as was done in last year's list, that this Table is in no sense to be taken as an accurate census of the diseases; for the number of farms visited forms a very small proportion of those in the sugar tract (6730 with five acres or over in 1926). Furthermore, the greatest attention was naturally paid to those tracts where disease had previously been noted, and there is no distinction between a number of farms close together and others widely separated.

During the year, typed circulars were distributed giving accounts of these five major diseases, under the headings: Distribution, losses, symptoms, cause, mode of infection, and control; the latter, under eradication, seed selection, and resistant varieties.

This is a very good beginning indeed, and when, in 1928, the Division is formally installed with its staff and laboratory, a great deal of pioneer investigation will have been got through. The cordial relations existing between the members of the staff in training and D. S. NORTH, who is in the employ of a private firm, are specially gratifying: and the benefit to the Government of Queensland is very heartily acknowledged through the Director. There is not space to go into the details of the Table referred to above, nor in its fragmentary state is this perhaps advisable; but one or two remarks may be made in conclusion. Gumming is markedly confined to the southern area, and leaf-scald to the northern. Mosaic covers a very considerable area, but appears to be practically absent now from the extreme

[1] See also *I.S.J.*, 1924, 528. The toll of cane diseases in the fields is estimated at 5 per cent.

north. Fiji disease is a recent invasion, only recorded for the Queensland fields during the past year ; its occurrence in 11 and 8 farms in two extreme southern districts appears to suggest that it has entered the tract from New South Wales. Leaf stripe occurs in three districts about the middle of the cane tract.

C. A. B.

The World's Sugar Consumption.

The Increase to be expected during the next Decade and the Capacity of the Different Countries to produce it.

By RUDOLF E. GROTKASS.

If we take a glance at the development of the World's sugar production during the last 75 years, which began in 1850 with about two million tons[1] (including an estimate of British India) and has reached 25,861,000 metric tons for 1925-26, and an estimate, according to Dr. Mikusch, of 24,586,000 tons for the present campaign, we are justified in drawing from these figures an idea of the progressive rate of the sugar consumption during this period. We find that consumption down to the late war doubled pretty nearly every 20 years. The respective figures are two millions for 1850-51, nearly four millions in 1870-71, over eight millions for 1890-91, to reach 15 millions in 1910-11. The last campaign before the war, that of 1913-14, brought the figure approximately to 19 millions.

The increase in the production of sugar up to the outbreak of war followed, according to Hodge,[2] a progressive rate of 3½ per cent. per year on the average since 1850. The war brought a retrogressive development in its train which reached the low level of 15½ millions in 1919-20. The recovery in the following years rose according to Camp[3] at a rate of 8 per cent. until 1925-26. This strong increase in the rate shows the tendency of both production and consumption to overtake the time lost during the war, and that the average 3½ per cent. increase has for the present been reached once more, nay even exceeded. According to this, one might say historical, review it seems quite comprehensible that the sugar market reacted with higher prices upon last year's lower crop estimate for 1926-27.

For a fair judgment of the development in consumption it is necessary to state that a certain quantity of actually used "sugar" does not appear in the available statistics. To this belong in first place the great amounts of syrups partly made direct from raw sugar before the latter enters the market, or from cane juice, cane molasses, maple and sorghum, the latter being manufactured in considerable quantities in different southern and northern territories of the U.S.A. and Canada. To this must be added the great amounts of glucose syrups manufactured from corn and potato starch and used in the confectionery industry. Further quantities of solids, i.e., crystallized glucose, maple sugar, and palm sugar (the latter manufactured in East Indies) have to be enumerated. The glucose industry particularly is becoming more and more an indirect factor on the sugar market. To complete the list of the above-mentioned products containing sugar in other forms and forming thereby part of the consumption, fresh cane juice together with raw cane and the great volume of all fruits in fresh state

[1] Tons in this article are metric (2204 lbs.) unless otherwise stated.
[2] *I.S.J.*, 1924, 595. [3] *Facts about Sugar*, 1926, 38.

eaten by the population everywhere must be mentioned as furnishing a quantity of sugar which it is impossible to ascertain by statistical methods.

A comparison between the increase in population and that in sugar shows at first sight that the former has not been the decisive factor. What we observe is a rather rapid alteration in dietic habits, particularly of the western white races, which, as it seems, are being copied also by the Eastern populations. What is this alteration, it may be asked ? It is a reduction in the use of bread, i.e., flour, as compared with former times. This development finds its confirmation when we consider the habits of countries with a low *per capita* consumption of sugar. Taking Russia and China for instance, we notice there an enormous consumption of bread and flour, from rye or rice. This correlation between high flour and low sugar consumption or vice versa is a fact. Any such change in our food balance has to be accounted for as the main factor in the rapid development of the sugar industry during the 19th century and after. This process for the world as a whole has not seen its end yet. A separate problem is the industrial consumption of sugar. At present sugar in the form of molasses is being used for the manufacture of yeast and alcohol, while during the war years raw sugar was the primary material for the manufacture of glycerin in Germany. Then the use of sugar in sugar-containing feeds has increased steadily along with the development of the beet sugar industry.

The fight between beet and cane, which began to be serious during the middle of the last century, was accompanied by the introduction of protective duties and bounties to balance the more luxurious vegetative growth of the tropics. It brought about a reduction in the price of sugar which met the increasing demand halfway and even stimulated it. But it is evident to-day that neither of the two alone could have been able to supply the amount necessary for the world's consumption.

In the Anglo-Saxon countries the consumption of sugar has attained figures which seem to indicate that the point of saturation is being reached there. On the other hand, the rate of increase in the United States has lately been much higher than in a number of countries with a much lower *per capita* figure. Reliable investigations on the precise position of the "point of saturation" have not so far been made. There is also a regrettable lack of data on the consumption of the different classes in the population, from the point of view of economic standing, as well as the influence of different occupations. Undoubtedly with such *per capita* figures as 110 lbs. (refined) for the United States and 120 lbs. for Australia there will be types of people with much higher and much lower figures respectively. Questions of economic nature may be of primary importance, but so may other factors also, of which we do not know anything to-day.

These varying conditions exist of course in all countries. Besides the great territories open to an increase in consumption in Russia and Asia, there are also quite densely populated countries of the Occident whose consumption figures are much below the standard set by the Anglo-Saxon countries. There is first Germany with 60 million inhabitants, which for 1925-26 had a *capita* figure of 48 lbs., a quantity still the same as that ruling before the war. The Belgian and French consumption which for the period from 1912-13 to 1924-25 mounted from respectively 35·6 lbs. and 43·3 lbs. to 50 lbs. and 51·9 lbs., offers still room for more. For Czecho-Slovakia a comparison with pre-war figures is impossible, but the post-war figures, beginning with 1921-22 of 50 lbs. and attaining now to 63 lbs., indicate a steady rising tendency. A constant figure has only been reached by Great Britain, which

since the turn of the last century has always been around 88 lbs. The greater States of Southern Europe, like Spain and Italy, with their lower average standard of life, have in the last 20 years doubled their figures.

The European consumption amounting to about a third of the world total saw a considerable increase from 1923-24 to 1924-25, amounting to 19·8 per cent. In the following year this figure dropped to 4·6 per cent. despite the great abnormal increase in the preceding year, a figure still above the normal average rate of 3½ per cent. For the present fiscal year it will be only a little lower. Similarly are the 1926 estimates for the United States and Canada (3 per cent. but in refined value). All this shows that Europe and North America have again arrived at the normal rate of increase of 3½ per cent. The yearly quantity for Europe and North America constitutes two-thirds of the world's total. The increase in the remaining third cannot be ascertained yet for the current year.

According to the 3½ per cent. ratio in the world's sugar production, a figure of 27½ million tons as the total of the sugar produced this year should have been reached ; this would have been the case if the war had not upset the economic balance everywhere. In the low level year of 1919-20 production was seven millions behind the possible calculated normal amount. With the crop of 1925-26, the quantity had caught up considerable arrears, lacking only two millions. The lower crop of the present year throws things back to three millions. The better prices for the present season prove that a continuation of the 3½ per cent. increase under fluctuations up and down may be counted upon. Of decisive influence will be political events, particularly in the Far-East where at present a strong tendency to become independent of European influence manifests itself. If we look at the aspects in the East from the point of view of sugar consumption, such a movement towards independence may be quite favourable, so long as any friction between the nations interested in China is avoided. Despite the serious news of the situation there, it is to be expected that the course of events will run for some time at least, without any such conflicts ensuing.

Therefore, it is appropriate to review the task of the world's sugar industry if 10 years' freedom from greater wars could be guaranteed to the world. After the observations of the last 75 years and on the assumption that the present three million tons of arrears *will not be regained*, the industry will have to effect an increase of at least 10 million tons by 1936-37, making production a round 34 million tons.

Now the question presents itself : From what territories, and up to what degree from the agricultural and technical point of view, will it be possible to furnish the world with this quantity of sugar ?

Beginning with the sugar beet growing countries there is first :—

Germany.—In 1914 the acreage in sugar beets amounted to 546,736 hectares[1] which means for the present reduced size of the Empire about 450,000 hectares. In the 10 years preceding the war a slow but steady increase of 130,000 hectares had taken place. The Versailles treaty transferred an approximate beet territory of 100,000 hectares with 18 modern factories of extra large size from Germany to Poland. The 1926 acreage amounting to 375,000 hectares is therefore still 75,000 hectares behind the last pre-war figure calculated on the size of the present territory. The sugar yields per hectare dropped during the war to an absolutely formidable degree, from 5-5½ metric tons to the low yield in 1919-20 of 2¾ tons. The larger portion of this decrease in yield has been regained, but the present figures

[1] 1 hectare = 2·47 acres.

are still at least 10 to 20 per cent. behind. The production of raw sugar during the last two campaigns before the war amounted to somewhat over 2,700,000 metric tons. If we estimate the loss sustained through the cessation of territory to Poland at 300,000 tons, we get a figure of 2,400,000 tons obtained as the maximum pre-war figure on the present size of the country. Considering the result of the production estimated for the last campaign of 1,650,000 tons, an increase of three-quarters of a million tons for the next decade seems reasonably possible, though it would not suffice to keep up Germany's share in percentage of the world's production. The large pre-war yields are also capable of a certain small improvement through the further increased use of fertilizers, on account of the new scientific advances made in the determination of soil requirements.

It must be stated here, before continuing, that the estimates given now and further on are only *potential figures*. They will not profess to indicate outright what is going to be achieved, but will just give an idea what, according to agricultural conditions and other known and calculable economic factors, can possibly be attained. Weather conditions, bounties, new duties, taxes, natural catastrophes, as well as political conflicts, are of course absolutely uncalculable in respect to their future influences on production.

Russia.—The acreage during the years 1913 and 1914 was respectively 750,000 and 730,000 hectares and the production 1,700,000 and 1,975,000 tons of sugar. The revolution brought about a total collapse of the industry. The present area has again reached 500,000 hectares with a production of over one million tons. Russia has, like Germany, suffered a loss of territory to Poland containing an estimated beet acreage of 80,000 hectares, together with a corresponding number of sugar factories. Considering all this, the recovery has been most remarkable. The unquestionable reshaping to conditions of normal trade, though going on at a slow rate, is making a further considerable increase a certainty. As unfavourable factors there have to be considered lack of capital and the number of idle factories situated in less favourable districts, where their reactivation is presenting numerous difficulties. Nevertheless an increase of 750,000 tons for the next 10 years is to be counted upon, which will put Russia in second place before Czecho-Slovakia amongst the beet growing countries.

Czecho-Slovakia.—The last three years have shown an average acreage of 300,000 hectares. The highest acreage registered in the former Austro-Hungarian monarchy ran up to 448,000 hectares in 1912, of which about 350,000 can be estimated as having belonged to the territory of the present Republic. While the area therefore is still behind, the relative sugar production of the pre-war years has been attained and even exceeded. In the last campaign the figure was rather low with 1,050,000 tons, against 1,429,000 and 1,510,000 tons in the preceding two years (Austro-Hungarian production in 1913-14 was 1,692,000 tons). An increase to 1,700,000 tons for the next decade must be considered as the maximum. The destruction of the economic unity of the provinces in the Danube valley through the peace treaties has raised great difficulties against the marketing of sugar in that region, and has forced the industry to seek other more distant zones for the marketing of its products. Therefore an increase in home consumption is the only outlet for a higher production, which should not exceed the above mentioned quantity.

United States of North America : Canada.—The acreage, which before the war amounted more or less to 550,000 acres, has exceeded 800,000

acres thrice since its close. The former production of 650,000 tons of standard granulated has increased several times to 900,000 tons. While beet cultivation is disappearing increasingly from California, and the Rocky Mountain States (Utah, Idaho and Washington) have suffered serious setbacks through the hitherto uncombatable Curly Top disease, the industry is making a steady headway in the big stretch of territory between the Rockies and the Great Lakes. Here are the possibilities to produce more than the entire U.S.A. domestic demand, amounting to six million tons.

The reason why home production has not been developed here to this extent is the fact that an enormous capital has been invested in the West Indies and in the territories in the Pacific Ocean, with the expectation of higher returns on the investment. The cost of production of Cuban cane sugar is well below that of American beet sugar. Since the reciprocity with Cuba and the establishment of preferential duties for this island in the United States were inaugurated, the beet sugar industry has developed gradually, but not so rapidly as the Cuban industry. For the present there are no indications that these centres of capital will be shifted to any great extent, but an increase of 400,000 tons of beet sugar until 1936-37 is to be expected.

In Canada production has increased lately through the opening up of new sugar beet territories in the West. An increase from the present 40,000 tons production to 80,000 tons is quite a feasible proposition.

France.—The greatest area in beets ever achieved was attained 26 years ago, in 1901, and amounted to 312,465 hectares with a record production of 1,110,000 tons of sugar; but in the last years before the war this figure had dropped below 800,000 tons. The beginning of the world war wiped most of the factories clean out of existence. On the other hand, the arrival of peace saw a great activity in reconstruction, so that at present the pre-war figures of production have been fully regained. At the turn of last century France was in a position to export considerable quantities besides satisfying the home market; but consumption has since risen to such an extent that additional amounts have to be imported. France will never be an exporting country again even under the greatest inducements. Last year's smaller crop of 675,000 tons may reach 900,000 tons during the period calculated, but that is about the maximum by now.

Poland.—The Polish sugar industry is an inheritance from German and Russian capital and industry. The agricultural conditions are exceedingly favourable and offer full play for a great extension. The development during the last five campaigns is as follows. Beginning with 1922-23 303,962 tons were manufactured, followed by 383,084, 489,904, 582,000 and an estimated production of 567,000 tons for the last campaign, the acreage in beets rising from 110,000 hectares to 187,000. Within the next 10 years Poland ought to show figures round 800,000 tons.

Italy.—The best Italian pre-war production attained was 82,350 hectares with 328,000 tons of sugar in 1913-14. The war resulted in 1917-18 being a minimum year with 102,000 tons. But in 1923-24 the highest pre-war record was exceeded with 346,770 tons and reached the extraordinary figure of 416,700 tons in 1924-25. A reaction was inevitable and the output then dropped to 155,000 tons, to reach again last campaign 305,000 tons. The 1924-25 production is about the maximum that may be expected.

Belgium.—Here the beet sowings and the sugar production have exceeded the highest pre-war figures. The last campaign brought a lower result, but the 230,000 tons produced are not much below the pre-war figures. In 1924-25 a round 400,000 tons was produced. This quantity must be

considered as the maximum which the Belgian sugar industry is capable of producing.

Holland.—The development here is similar to that in Belgium. The years since the war have brought here also a little increase. The last production was 275,000 tons. If great districts like the Zuyder Zee territory are not reclaimed from the ocean, the 380,000 tons made in 1920-21 should mark the maximum capacity of this country.

Spain.—For a long course of years no particular advance in the industry of this country has been noticeable. Only since 1922 have considerably heavier crops been produced, comprising successively 178,000 tons, 185,000, 280,000, 273,000, and for the last campaign an estimated 250,000 tons. But a production of 350,000 tons will be within the capacity of this country.

Great Britain.—Here we have an industry of very recent origin, built up rapidly by means of a subsidy. As this subsidy ceases before the lapse of the 1928-37 period we are considering here, and only a rather low duty would remain as protection for the industry, its ultimate future is at present still uncertain. Before the expiry of the subsidy, however, a further increase should be counted upon. Production rose from 57,000 tons to 148,000 tons in the last campaign, and might conceivably reach 300,000 tons.

Denmark and Sweden.—In these two countries production has about equalled the home demand of late years. Any particular increase above the demands of home consumption is not to be expected. All told, an addition of 100,000 tons for both countries may be assumed.

Amongst all the other small territories, there is only Hungary which has been able to increase its production beyond the home demand. But the fight for the Central European sugar markets in the Danube valley is so keen, that under the present fiscal conditions any further increase is faced with too many difficulties.

With the exception of Austria which during the prescribed time ought to produce an extra 100,000 tons, the other Danube States such as Yugo-Slavia, Rumania, Bulgaria, and Turkey, have, with the exception of Bulgaria and Turkey, risen close to their rather low home requirements. A further increased production is meeting, as stated above, the competition and local over-production in the Danube territories. For all these other countries an arbitrary maximum figure of 200,000 tons may be calculated.

Any increase in the beet industries of Japan and particularly China cannot be calculated, on account of the unsettled internal situation of China, which will probably last for some time yet to come. And only Argentina and Uruguay are likely to provide recruits for the beet sugar industry in the near future.

(To be continued).

The Czecho-Slovak sugar production during 1925-26 is now officially reported to have been: Number of sugar factories at work, 166, of which 102 were raw sugar establishments, 53 were "mixed," and 11 were refineries; total number of workers, 69,393; area under beet cultivation, 307,405 hectares; roots worked up, 8,824,175 tons; sugar production (in raw sugar equivalent) 1,507,344 metric tons; of which exported, 1,079,910 tons. The principal destinations of the exported sugar in order of quantity were; Hamburg, Great Britain, Trieste, Switzerland and Austria.

It is reported that the Hungarian Agricultural Association and the Association of Hungarian Sugar Manufacturers are arranging an international competition with the object of ascertaining the best method of mechanically lifting and topping sugar beets.

Recent Work in Sugar Cane Agriculture.

ANNUAL REPORT OF THE INSULAR EXPERIMENT STATION OF THE DEPARTMENT OF AGRICULTURE AND LABOUR OF PORTO RICO, 1924-1925.

This Report enumerates a very great amount of work in all departments of Tropical Agriculture; and it is a question whether the limited staff should be encouraged to spread its energies over so wide a field. Presumably this is in accord with the wishes of the administrative authorities. Sugar cane is by far the most important crop in Porto Rico, and calls for more individual attention than it can possibly receive in the circumstances; but a good deal of useful work is, nevertheless, recorded at intervals in this long Report. It is pleasing to note one result of the more liberal policy regarding the salaries paid to the scientific staff during the two year period; this is at once evident in the usual Table of changes of staff during 1924-25. Of the 20 superior appointments in the list, only four were vacated during the twelve months—which is an unusually low figure for Porto Rico. But the salaries are by no means high and, what is more, there is no security that the scale of pay will be continued when the appropriations are passed for the next two-year period. Those who leave, generally do so because of more financially attractive offers elsewhere; and there is no question that this state of affairs is highly uneconomic. If matters are not in some way stabilized, Porto Rico will have to be content to play the part of a training ground of men for service in other countries, which have apparently only to offer superior money inducements to attract the officers of the Insular Experiment Station. It is every where recognised that, in a tropical country, it takes a year or two for even the best trained men to accustom themselves, on arrival, to the new conditions of environment. Irreparable loss was caused to Porto Rico, to quote only one instance, by its failure to retain the services of F. S. EARLE, and we see that, among those who have vacated their positions during the year, G. N. WOLCOTT has obtained a more attractive post in Haiti, carrying away with him a vast amount of experience of the pests of the sugar cane and other crops of the island. The Experiment Station continues to be starved, as anyone reading the Report can easily see, in other directions than the salaries of its officers; for a number of pieces of work have had either to be curtailed or abandoned in the attempt to make ends meet with the funds voted by the Legislature. At the moment, it is fortunate that the Commissioner in charge is both willing and capable; but it is pointed out that here too there is no certainty as to the future, because C. E. CHARDON may at any time be transferred, and a successor be appointed, without his keen interest and self-imposed research into the critical aspects of the sugar cane industry. Although then, as the Director points out, things have improved during recent years, there is none of that stability which is so necessary for scientific men to set about their various tasks, with confidence that their labours will not be unfruitful through no fault of their own. As to the perennial starvation referred to above, one example will suffice: we note that the sum of money spent on "books" for the fine library to which Porto Rico owes so much is put down as $6·12 during the year: a sum that is so obviously inadequate, that further comment is unnecessary.[1]

Looking through the various reports of the Director and the heads of the various sections, covering 140 pages of print, it is specially worthy of note that the question of the varieties of cane to be grown holds the premier position, as regards the sugar industry. This is in charge of A. H. ROSENFELD,[1] a recent recruit, with large experience; and it is obvious that a great deal of

[1] These remarks, referring to the year 1924-25, are in no way invalidated by what is known to have happened since.

important work is being commenced. The number of varieties under trial has considerably increased during the year, the figures showing a rise from 157 in 1924 to 203 in 1925. The varieties introduced vary as the poles as to their quality and resistance to mosaic, and presumably in the purpose of their introduction. Thus we note such half wild canes as Kassoer at one end of the scale and the best tropical canes at the other. Among the latter are BH 10 (12) and S.C. 12 (4), and one wonders how they will get on with the mosaic-carrying members of the POJ series. The work in this one project is almost unending. That these two fine tropical canes are eagerly sought after is shown by the list of sets distributed during the year, the Barbados seedling accounting for one fifth and that under the name of St. Croix one seventh of the total 12,443 bags of seed distributed.

The most important papers published during the year are contained in five numbers of the excellent " Journal " ; and among these sugar cane holds a prominent place. One number is devoted to Banana anthracnose, another to Entomological papers, a third to a series of papers on Plant Pathology ; while one contains a number of papers on Sugar Technology, and the last is devoted to a long discussion on Java POJ canes in Tucuman and Porto Rico.

Report of the Secretary of the Sugar Bureau of India, 1925-26.

The following are the chief points of agricultural interest in the above Report. Ten new Coimbatore seedlings found promising in 1924-25 were planted again in small plots without irrigation to compare them with the standard Co 213. Of these Co 273, 282 and 290 appear to be of sufficient merit for further trial. Co 290 is at present the most promising—a moderately thick cane which tillers well and makes vigorous growth : it withstood the prolonged drought very well, and has thus far not been affected by mosaic—and will now be grown on a large scale for mill trial. Another batch of 13 seedlings, Co 294 to 306, received in February, 1926, are being grown at Pusa, some of them being crosses between Co 213 and 214, which have hitherto proved so successful in Bihar. At Coimbatore the sucrose content and vegetative characters were good ; and thus far their growth in the plots is very vigorous and their tillering powers are also good. Co 275 and 280 are being tried again. Co 205, which has proved successful in the widely differing conditions of the Punjab, was grown on an estate scale, and gave a yield of 600 maunds (82 lbs.) of cane per acre. As this cane is credited with satisfactory growth on poor land with indifferent treatment, succeeding both under drought conditions and in water-logged soil, it is being multiplied for seed distribution.

Certain manurial experiments have been started, two for the local Chilean Nitrate Committee and one for the Produce & Chemical Co. of London. The use of sulphate of ammonia and nitrate of soda appears to be increasing in Bihar, and a depot is to be opened by the British Sulphate of Ammonia Federation in the district, for the benefit of small growers of cane. As sugar cane does not receive any manurial treatment worthy of the name, sulphate of ammonia and sodium nitrate are expected to give good results, if applied at the break of the rains (when rapid growth sets in) ; and the result of this propaganda will be awaited with interest. Experiments in spacing the rows of these thin canes appear to show that Co 213 should not be planted closer than three feet apart, while, with the thinner Co 214, this might with advantage be reduced to two and a half feet, which will still allow the interculture locally practised. It is usual to plant the canes in February, in which case the emerging shoots are often seriously injured by the shoot borers, at

a time when growth is slow. By planting in October, as soon after the rains as possible, it is claimed that this danger may be avoided. A greater yield has also been obtained in the experiments, and the ripening of the cane is somewhat earlier. Some of the planters have already started this planting in October, and the change should confer great benefit on the industry as a whole.

The distribution of sets of Co 210, 213 and 214 continues. With the help of funds placed at the disposal of the Bureau by the Indian Sugar Producers' Association, nearly 31 acres have been planted with these three kinds and the added Co 232. Unfortunately, the land selected proved to be "quite unsuited to the sugar cane," and the yield of sets suffered accordingly; Co 232 showed itself very susceptible to Mosaic, and as its yield is not high this cane has now been discarded. Co 214 has a crooked habit and comparatively low tonnage, but it is the hardiest of the three and comparatively disease free. It has been found to thrive very well on usar (alkali) land, is the earliest in ripening, and has been given a premium by one important group of factories to encourage the cultivators to grow it, since it was found to be reasonably satisfactory from the sugar making point of view. Co 210 does well in light land, and has also proved successful on heavy lands subject to flooding. Native growers keep it as a reserve against Co 213, and some actually prefer it to that seedling, it has been found so far to be less susceptible to mosaic. Co 213 produces the heaviest tonnage, but requires strong land and good manurial treatment: when properly grown the yields have been excellent. It is liable to attacks of mosaic and smut, but as yet the damage has been insignificant. About 1500 maunds (of 82 lbs.) of seed cane were distributed from this area, chiefly in Bihar, besides another 1000 maunds which were obtained from the manager of Bhikanpore factory.

It will be noted from the preceding that a very careful note is being taken of the susceptibility of the Coimbatore seedlings to mosaic, which has now been definitely established as occurring in the Bihar tract, and attacking the local cultivators' cane Hemja. In this study the assistance of the Mycologist is readily given; and plots are laid out with rows of Coimbatore seedlings alternately with mosaic infected plants. Because of the increasing agricultural work of the Bureau, four overseers have been added to the staff, for the purpose of observation and propaganda. This scheme appears to be working very well, and special attention is devoted to cultivation, manuring and disease phenomena. During the year, 36 concerns have been visited, and 1600 acres of cane in 100 villages have been examined.

The writer of the Report concludes with the remark that, during the five years between 1921 and 1926, nine Coimbatore seedlings have been grown and tested on an estate scale, out of 58 received from Coimbatore for trial. Five of them have been tested in the factory (Co 210, 213, 214, 232, and 233) and, as the result of testing, the last two have been rejected. Of the first three over 61,000 maunds of seed cane have been distributed, chiefly in Bihar but also to other parts of India. Further field tests are now being conducted with Co 275 and 280, while Co 205 is being given out for low lands; and among new seedlings Co 290 appears to be very promising. Hitherto this distribution work has been financed by the trade, private bodies interested in the improvement of the Indian sugar industry. It is further mentioned that, but for these improved cane varieties, and the duty of Rs. 4 to 8 on each hundredweight of imported white sugar, it is very doubtful whether the Bihar industry would have been able to hold its head above water, in these days of low prices.

Recent Work in Sugar Cane Agriculture.

REPORT OF THE OPERATIONS OF THE DEPARTMENT OF AGRICULTURE, MADRAS PRESIDENCY, 1925-26.

In certain circles it has become the custom to hold up the cultivation of the sugar cane in India and the manufacture of sugar from its juice as a striking example of inefficiency and wastefulness; and it is perhaps not realized how steadily though slowly progress is being made, all along the line. This is well shown in the present Report, hailing from a part of India, well within the tropics, where good tropical canes can be grown, and a yield of raw sugar (jaggery) obtained equal to that in most tropical cane growing countries. The average annual production in the Presidency is well over two tons per acre, and in some cases three to four are not uncommon. It is well to remember that the people of India are independent of outside markets and make their sugar for their own use: it is exactly adapted to their food requirements and, incidentally, is probably both sweeter and more nutritious than the white sugar on our tables. Indians do not make white sugar and do not want to.

The three main lines of improvement in the Madras industry during the last 30 or 40 years have been connected with the kinds of cane grown, the type of mill used, and the method of treating the juice. It is not so very long since the old, primitive wooden mills gave place to neat, efficient ones with upright iron rollers, at first two but more recently three together. Such small mills are eminently fitted to the local conditions, and can be easily worked with the pair of cattle attached to each holding, however small. Owing to the subdivision of the lands and the long rotation practised in cane cultivation, the actual cane fields are very small and widely scattered (excellent for the restriction of diseases and pests); and a grower must be able to cut his cane and make his jaggery at his own convenience. But there has been great waste of money in boiling the juice; a large iron boiling pan was placed on a hole in the ground in which a fierce wood fire was burning; and, to prevent charring, the pan had to be thick, and thus it was very heavy and costly. Here, then, were two distinct faults, the great cost of wood and that of the pan. This matter has engaged the attention of the local Agricultural Department for a good many years, and slight improvements have been introduced from time to time. But within the last few years a new type of furnace, with a small chimney to give a draught, originating we believe in the Central Provinces, has been adapted to the local conditions, with the result that much lighter pans may now be used, and the expensive wood pile can be entirely replaced by the bagasse and trash of the cane fields. The cost of the new installation is practically the same as the old; and the cost of the wood is saved, while, because of the absence of charring, the jaggery fetches a better price. It is estimated that the total benefit conferred by the new process is something like Rs. 90 per acre (£6 15s. 0d.). This improvement has been only attained, during the last few years, by an intensive propaganda on the part of the officers of the Department: "in many districts the new furnace is now in common use, and in the Coimbatore district the chimneys are quite a feature of the landscape, over 500 of them being at work." The really significant point in the whole business is that this improvement can be instituted at no additional expense, and does not make the work harder; and this point should be carefully noted. So-called improvements, although in the long run they may be perfectly valid, will not have much chance against old established practice, if there is greater labour connected with them or if they cost more at the start.

The improvement in the kind of canes grown in Madras may be said to have commenced some quarter of a century ago; and the fields have under-

gone little short of a revolution since then, again owing to the labours of the local agricultural department. Thick tropical canes of good sugar content or resistant to the local cane diseases have now largely ousted those prevailing at the beginning of this century introduced many years or even centuries ago; the indigenous north Indian canes never had a great hold in Madras. We read that Red Mauritius, one of the first of these better kinds, is now the chief favourite; but J 247, also introduced early, and Fiji B (Badila) are steadily growing in favour, while in many places Barbados seedlings and Java Hebbal are spreading. At the moment, however, the new furnace is the main line of propaganda in the sugar cane work of the Agricultural Department.

COLD CHLOROSIS OF SUGAR CANE. **J. A. Faris.** *Tropical Plant Research Foundation. Scientific Contributions, No.* 3, 1926.

This is a discussion of the cause of peculiar white bands noted by the author on the leaves of Yellow Caledonia canes in Cuba during the winter of 1924-25. Several fields were affected and many plants showed a uniform marking of this nature, while in the adjoining fields of Cristalina no white bands were present. The country people attributed it to cold snaps during the winter. The author again observed similar markings in December, 1925, on several kinds of cane growing in the Experimental Station attached to the Foundation, and other cases were noted elsewhere. To determine the cause an experimental study was commenced. The chlorotic bands were two to four inches in length, while their width varied from right across the leaf to only a narrow strip along the edge. In the former case the bands were seen on a number of leaves in the same cane tuft, and were obviously connected with some factor occurring when the leaves were still close together in the bunch, and before they separated out and became mature. Thus, the marks appeared lower down in the older leaves, and higher and higher in the succeeding ones: growth in length of a leaf only takes place in a small area near the base. In general appearance the bands were very regular, and looked almost as if something had been placed over a portion which inhibited the formation of chlorophyll. The experiment consisted in placing a collar filled with iced water round the base of the expanding shoot, and this resulted in distinct chlorotic areas being formed, although not quite so sharply marked as in nature.

A study of the temperature and rainfall records during the season 1925-26 showed that an outbreak of leaf banding occurred at every time when a low temperature succeeded a rainy period; and this is graphically shown in a diagram. The natural explanation of the phenomenon is as follows: "Usually winter rains in central Cuba follow the continental storms of the North and are, as a rule. followed by colder weather. Such conditions stimulate growth in the cane, and then the cold water standing in the cornucopia of the stalk chills the newly exposed tender tissues, thus causing the chlorosis of the leaves affected."

A Table is appended giving the reactions of 20 different varieties to cold chlorosis, and a much longer list is also given of forms which at present appear to be resistant. H 109 and D 1135 appear to be very susceptible, and are closely followed by D 99. It is pointed out that "sectional chlorosis" has been reported by D. S. NORTH in Australia, by A. H. LEE in Hawaii, and by BRANDES in Louisiana; the first of these suggested the connexion between this chlorosis and cold weather. The author concludes that frost is not necessary for the occurrence of cold chlorosis, but that a temperature as low as 10°C. is sufficient to cause it in the more sensitive varieties.

COMPARATIVE PHILIPPINE YIELDS OF SUGAR PER HECTARE FOR THE 1924-1925 CROP. *Sugar Central and Planters News, Vol. VII, No. 5, Manila, May 1st, 1926.*

The Philippine Sugar Association has now obtained fairly complete records of yields of sugar throughout the islands, because this year practically all of the Centrals (excepting Manapla) have sent in returns. In the present year there are 22 returns, as compared with 16 last year and 12 the year before. In most cases, however, the yields are only approximate, because the haciendas have not yet been surveyed. All of this information is given on Table I, both for plant canes and ratoons, the yield being uniformly greater in the former. The number of hectares (of 2½ acres) under plant canes in 1924-25 was 20,358, as against 12,767 under ratoons.

During the three years, the average number of piculs per hectare[1] for the estates reporting was 57·00 in 1922-23, 60·50 in 1923-24, and 75·77 for 1924-25. The great increase in the last year is put down partly to the more extensive use of manure, but more especially to "exceptionally favourable, although unseasonable weather conditions," particularly in Negros. The growth of the cane was prolonged and the tonnage thereby increased, the milling season also being extended for two to three months beyond the normal. Of the Centrals where the acreage is known because of a survey of the fields, Bais showed the highest yield, of an average of 156·45 piculs per hectare for plant cane and 114·04 for ratoons. San Carlos followed very closely and the plant canes there provided the highest average yield obtained in the Philippines, namely, 164·36 piculs per hectare, or close on four tons of sugar per acre, which is very satisfactory. Most of the Centrals reported considerable increases over previous years, but three showed a decrease of from 3 to 18 piculs.

Tables II to VII give records of previous crops of several of the big Centrals. With these data, the Philippine Sugar Association is endeavouring to gain information as to the effect of various factors on the yield of sugar in the Philippine Islands, such as climate, soil, drainage, irrigation and manuring.

PHILIPPINE AGRICULTURAL BIBLIOGRAPHY. *Part I. Check List of Bulletins, Circulars and Miscellaneous Publications of the Bureau of Agriculture, with Index thereto. E. R. Alvaradi, Manila,* 1926.

The literature in the various branches of Agriculture in different countries has accumulated during recent years at such a rapid rate that it is becoming impossible to keep up to date, even in the work done on a single crop. The student almost welcomes the comparatively restricted studies concerning cacao, sisal, oil palms, coconut and rice, after struggling with the mass of publications on rubber, sugar cane, cotton, and citrus. In a certain number of cases it is the custom to print within the cover of bulletins lists of previous work published, and this is a very useful procedure. But the time is rapidly approaching when something more than this is required; and such carefully compiled summaries as that under reference are necessary, if one is to form an estimate of the agricultural research being done in the tropics. Even in such a short space of time as 25 years, there is a danger of previous papers being lost sight of; many are out of print, and can thus be no longer obtained, to the great loss of present day workers. The author writes as follows: "In going over the records of the Bureau of Agriculture, it is amazing to find

[1] To convert a number of piculs per hectare into long tons per acre it will be sufficient to divide it by 42.

what a wealth of agricultural literature was written by the former American technical personnel of this Bureau, who did pioneering work in scientific agriculture in the Philippines, and by the technical Filipinos who later continued and are continuing the work of the former."

The present list, with its subject and author indexes, is merely the first of three, to be followed in due course by a list of articles written in the serial publications of the Bureau, and yet another list of articles written by the personnel of the Bureau and published elsewhere, each with its appropriate indexes. The literature of tropical agriculture is of necessity extremely scattered, and although here and there a useful textbook has been published on some crop, these very quickly get out of date, because of the wealth of new work being done. The textbook period has really not yet arrived in the study of most tropical crops, and it is and will remain for some time essentially a pamphlet and journal subject. The scientific study of the sugar cane in the Philippines is comparatively recent, and we see that only about a dozen bulletins have been as yet written on it, with one handbook of the industry, which is already out of print. When the other lists appear, we shall expect a far greater number of references to the sugar cane, which shows that the usual printing of a list of bulletins is sometimes of only small value to students. This move is to be cordially recommended to all countries in the tropics where scientific work is being done on the crops.

C. A. B.

The Potentialities of the Development of the Philippine Sugar Industry.

By GEO. H. FAIRCHILD,

Secretary-Treasurer of the Philippine Sugar Association

Many inquiries have of late been received regarding the immediate possibility of a rapid development of the sugar industry of the Philippine Islands, similar to that which took place in Cuba within the last few years. As much of the literature on this subject is silent on the history of the development of the Philippine sugar industry, a knowledge of which is essential to an intelligent forecast of the future, the Philippine Sugar Association has approved and authorized for publication the following statement of facts and data.

While one of the erroneous impressions featured in the sugar world is to the effect that the Philippine sugar industry is of recent development dating back a little more than a decade, if one reads its history published in the Compilation of Committee Reports of the Association for 1925, it will be found that long before either the Hawaiian cane sugar or the European beet sugar was a factor in the world's sugar markets, Philippine sugars were already being sold abroad in considerable quantities. According to the U.S. Customs' reports published in 1795, 132 long tons of sugar were exported from the Philippines to the United States. From other reliable sources we find that during the first half of the 19th century the Islands were exporting from 10,000 to 50,000 tons of sugar annually, while the average annual sugar exportation of the last twenty years of Spanish administration amounted to 192,207 tons. In 1895, the Philippines exported a total of 341,470 metric tons of muscovado sugar, a record which was not exceeded until so recently as 1922 when exports rose from 289,876 tons in the previous year to 362,072 tons, of which 237,829 tons were centrifugals,

119,368 tons muscovados, and 4875 tons refined. That the Philippine sugar industry was an established industry before MAGELLAN discovered the Philippines is a fact, since history records its introduction from India and Java, where sugar cane is believed to have been first cultivated, although some Filipinos believe it to be indigenous to these Islands.

Despite the great age of the sugar industry in the Philippines, its development has not been as rapid as that of neighbouring countries, this being very clearly demonstrated by the following statistics[1] in which the exportation of sugar from the Philippine Islands during American occupation is compared with the latter 28 years of Spanish regime :—

Spanish Administration (1870–1897)	(Metric Tons of 2204 lbs.).	U.S. Occupation (1898-1925)	(Metric Tons of 2204 lbs)
1870	78,211*	1898	180,818*
1871	87,464*	1899	85,828
1872	95,525*	1900	65,191
1873	85,210	1901	98,596
1874	101,371	1902	56,873
1875	128,112	1903	85,308
1876	130,547	1904	87,053
1877	122,994	1905	108,499
1878	122,023	1906	129,454
1879	131,859	1907	127,917
1880	181,190	1908	144,735
1881	208,806	1909	129,328
1882	150,423	1910	121,472
1883	196,835	1911	209,044
1884	122,128	1912	197,076
1885	204,222	1913	157,334
1886	184,940	1914	236,498
1887	170,754	1915	211,013
1888	160,988	1916	337,490
1889	228,469	1917	205,908
1890	144,841	1918	273,258
1891	138,218	1919	136,060
1892	252,798	1920	180,341
1893	261,522	1921	289,876
1894	210,646	1922	362,072
1895	341,470	1923	271,983
1896	229,911*	1924	357,830
1897	202,091*	1925	546,832
Total exportation	4,673,568	Total exportation	5,393,687
Annual average..	166,913	Annual average ..	192,631

From the foregoing figures it will be seen that the status of the Philippine sugar industry had become relatively dormant, compared with the development of the industry in Formosa, Java, Porto Rico, Hawaii, and Cuba. Immediately prior to America's advent in the Philippines, the exportation of sugar amounted in 1897 to 202,091 metric tons, or a total production of 252,091 tons, assuming that 50,000 tons were consumed locally. Last year, the Philippines produced 369,576 metric tons of centrifugals, and approximately 150,000 tons of muscovados, 66,750 tons of the latter having been

[1] From Statistical Bulletins Nos. 3 and 7, Bureau of Commerce and Industry of the Philippines.

* From 'Concerning Sugar."

exported, the balance being consumed locally, or a total production of 549,576 metric tons of centrifugals and muscovados. In other words, for a period of 29 years, the increase in the sugar production of the Philippines amounted to 297,485 metric tons or approximately 120 per cent. During the same period, Hawaii increased its production from 208,120 metric tons in 1897 to 716,669 metric tons in 1926, or an increase of 245 per cent.; Java from 586,292 metric tons to 2,315,470 metric tons, an increase of 295 per cent.; Porto Rico from 54,866 metric tons to 553,221 metric tons, an increase of 908 per cent.; and Cuba from 215,454 metric tons to 4,963,042 metric tons, an increase of 2203 per cent., while during the last 15 years the production of Formosa increased from 50,000 metric tons in 1910 to 500,000 metric tons in 1925, an increase of 900 per cent. Thus, while the Philippines were increasing their production 120 per cent., Hawaii, Java, Formosa, Porto Rico, and Cuba increased theirs 245 per cent., 295 per cent., 900 per cent., 908 per cent., and 2203 per cent. respectively.

The increase in yields of recent years has been largely due to replacing antiquated with modern methods of sugar production and manufacture, in which the low-grade sugars known as "muscovados" restricted to but one market—China—and penalized in all the world's markets, were placed with centrifugal sugars. This change which stimulated the introduction of better methods of cane cultivation followed the granting of the preferential tariff now being enjoyed by Philippine sugar in the U.S. markets, and resulted in the substitution of from 1500 to 2000 muscovado mills producing 250,000 tons by 34 modern centrals of a combined capacity of 500,000 tons, thereby releasing for cultivating increased cane areas in the old developed districts thousands of labourers who were no longer required to operate the antiquated muscovado factories. As a result of the change which has been made during the last decade, about 80 per cent. of the sugar now produced in the Islands is in the form of centrifugals, polarizing from 96° to 97°. This development is clearly shown in the following table compiled from reports of the Philippine Customs, detailing the sugar exports of the Islands for the last 10 years segregated to centrifugals, muscovados, and refined.

The Sugar Exports of the Philippines for the Last Ten Years.
(Metric Tons of 2204 lbs.).

Year.	Centrifugals.	Muscovados.	Refined	Total
1916..	37,500 (est.)	337,355	135	374,990
1917..	47,224	158,685	—	205,909
1918..	64,018	209,240	—	273,258
1919..	29,860	106,173	27	136,060
1920..	53,196	127,141	3	180,340
1921..	162,427	127,433	17	289,877
1922..	237,829	119,368	4,875	362,072
1923..	226,170	44,962	851	271,983
1924..	296,242	57,057	4,531	357,830
1925..	459,273	83,334	4,225	546,832
Total	1,613,739	1,370,748	14,664	2,999,151

In this connexion it should be noted that practically the entire crop of centrifugal sugar is exported to the United States, while all of the muscovado sugar is absorbed by the Chinese and Japanese markets.

The rapid change from muscovado to centrifugal sugar production is unique, but as a majority of the sugar centrals were erected in the boom years of 1919 and 1920 when the cost of materials was at their peak, the

Philippine sugar industry, except in a few instances, has not been as profitable as reported by some writers. The status of some of the centrals erected in recent years is a good example of the difficulties being encountered in the production of centrifugal sugar in the Islands.

Excluding the first centrifugal factory which was erected in 1910 on the Island of Mindoro, all other centrifugal sugar factories were erected in localities where muscovado sugar had been produced for decades, supplanting innumerable old established muscovado mills. While there are still large areas of lands available in Mindanao and the central plain of Luzon which can be made suitable for cane growing, the expense of developing these lands while not prohibitive would be relatively slow and expensive gauged by previous pioneering experiences in similar unsettled and uninhabited areas. Take. for example, the labour required for extensive development of such large areas ; it is not only limited and difficult to attract from the congested to unsettled regions, but likewise exceedingly costly since all of the expense will be for the account of the "exploiters." Experiences of Mindoro Sugar Company conclusively demonstrate the difficulties of opening up unpeopled, virgin lands, for the cultivation of sugar cane. Other difficulties which tend to discourage further expansion in the sugar industry of the Islands in unpopulated districts are the local land laws, the attitude of the leaders of governmental policies towards the development by foreign capital, and the instability of the present political status upon which also depends the preferential tariff without which sugar cannot be produced successfully in competition with Java and Formosa, or even far-distant Cuba. So long as the political status of the Islands remains unsettled, capital has hesitated and will hesitate to invest in these Islands, and were the status settled to the satisfaction of the most exacting capitalist, the labour problem will still present great difficulties.

There is, moreover, the uncertainty of weather conditions which have a very pronounced effect on the annual sugar production in the Philippines, constituting one of the uncontrollable factors of cane cultivation. The fluctuations in yields from one year to another as a consequence of the variable weather conditions may vary in some localities from 25 to 50 per cent., over or under a mean of five years. The crops of centrifugal sugars are segregated to islands in the following table :—

(Metric Tons of 2204 lbs.).

Name of Island	1926/27 crop.*	1925/26 crop.	1924/25 crop	1923/24 crop	1922/23 crop.	1221/22 crop.
Negros	337,927	244,600	370,698	237,561	161,996	149,050
Luzon	119,024	113,317	111,893	69,828	59,492	66,215
Panay	14,548	7,615	9,543	3,554	986	695
Mindoro	4,111	4,044	5,496	4,654	3,824	5,787
Total	475,610	369,576	497,630	315,597	226,298	221,747

Note.—The variations in the sugar production of the Philippine Islands for the period 1924/25 and 1925/26 are mainly found on the Island of Negros and are due to unfavourable seasonal conditions. Because of the exceptionally favourable weather conditions throughout the planting, growing and harvesting season, 1924/25 is classed as a "bumper crop year." Due to exceptionally unfavourable weather conditions during the planting season of 1925/26, this year is classed as a "crop failure year," of which there have been three in the last quarter of a century. The 1923/24 season is classed as a "normal crop year."

* Estimated.

With the development to date as a guide, the annual sugar production of the Islands for the next 10 years may vary from 450,000 to 750,000 metric tons, an average of 600,000 tons annually. With favourable weather conditions such as prevailed during the 1924/25 crop, better methods of cultivation, seasonal application of appropriate fertilizers, the introduction of new and improved varieties of cane, and the gradual increase in the cane areas in the developed districts, the Philippines may produce as much as 750,000 tons of sugar in a bumper crop year. On the other hand, in years of abnormally unfavourable seasonal conditions, production may decline to 450,000 tons. In an article entitled "The World's Sugar Situation," published in the July 10, 1926, issue of *Facts about Sugar*, the writer calculated that to provide for the annual increase in consumption, the world's sugar production for the next 10 years should be as follows :—

		Long Tons of 2240 lbs.
Production for 1925/1926	should not exceed ..	.. 23,268,000
„ „ 1926/1927	„ „ „ ..	.. 24,351,000
„ „ 1927/1928	„ „ „ ..	.. 25,489,000
„ „ 1928/1929	„ „ „ ..	.. 26,683,000
„ „ 1929/1930	„ „ „ ..	.. 27,937,000
„ „ 1930/1931	„ „ „ ..	.. 29,254,000
„ „ 1931/1932	„ „ „ ..	.. 30,636,000
„ „ 1932/1933	„ „ „ ..	.. 32,092,000
„ „ 1933/1934	„ „ „ ..	.. 33,616,000
„ „ 1934/1935	„ „ „ ..	.. 35,216,000

Assuming this basis to be correct, in 10 years, or in 1934/1935, the sugar-producing countries must produce at least 12,000,000 tons more sugar than they are producing at present to meet the annual increase in world consumption, of which quantity that of the United States alone represents approximately 3,000,000 tons. From what sources will this sugar come to supply the increased demand in the United States for the next 10 years? Since the Philippines will be able to contribute a maximum of 250,000 tons, the balance of 2,750,000 tons will have to come from Cuba, Hawaii, Porto Rico, and the U.S. sugar beet districts; but Hawaii and Porto Rico have about reached the apex of their productive limit, so that even Cuba's annual maximum production of 6,000,000 tons will readily be absorbed by the United States.

Basing the future on the experience of the past, there is no justification for the apprehension that the Philippines in the near future will be an important factor either in the sugar markets of the United States or of the world. What is needed more than anything that has been previously suggested to prevent Philippine sugar from adversely affecting the interests of other exporters to the U.S. market is a co-ordinated and comprehensive plan for the marketing of our sugars at such times and in places as not to disturb the market for other American sugars. The difficulties of giving effect to this suggestion are obvious, since sugar—unlike cotton, rubber, and coffee—is a commodity which is produced throughout the world. If it is impossible for the sugar producers to avail themselves, when in distress, of the means adopted by producers of other agricultural products, the law of the "survival of the fittest" will prevail.

Carbon tetrachloride decomposes in water with the formation of hydrochloric acid, in spite of which fact the compound appears on the German official list as a denaturant for alcohol, the amount specified being 1·5 litres per 100 litres of the spirit. A case is reported in which alcohol denatured in this way was placed in an iron drum, which previously had held pure alcohol for some years, the drum then becoming so badly corroded as to be unfit for use within 14 days.

The Maxwell Milling System.

The "Crusher-Shredder" and other Maxwell Patents in Operation.

By A MILL ENGINEER.

Introduction.—The inauguration of the Maxwell system of milling occurred this year at Central Espana in Cuba. Before discussing this entirely novel—indeed admittedly revolutionary—method of juice extraction from the sugar cane, it may be well to make a few prefatory remarks about the scene of operation.

Central Espana is amongst the largest factories in Cuba, turning out last crop 70,000 short tons of sugar. As to the magnitude of its milling plant proper, Espana ranks amongst the half dozen biggest centrals,[1] having a double tandem of a crusher and six mills 36 in. × 84 in. each, with a grinding capacity of over 150 tons of cane per hour per tandem, thus a total daily capacity of about 7000 tons of cane.

The milling plant of Central Espana is diagrammatically shown in Fig. 1.

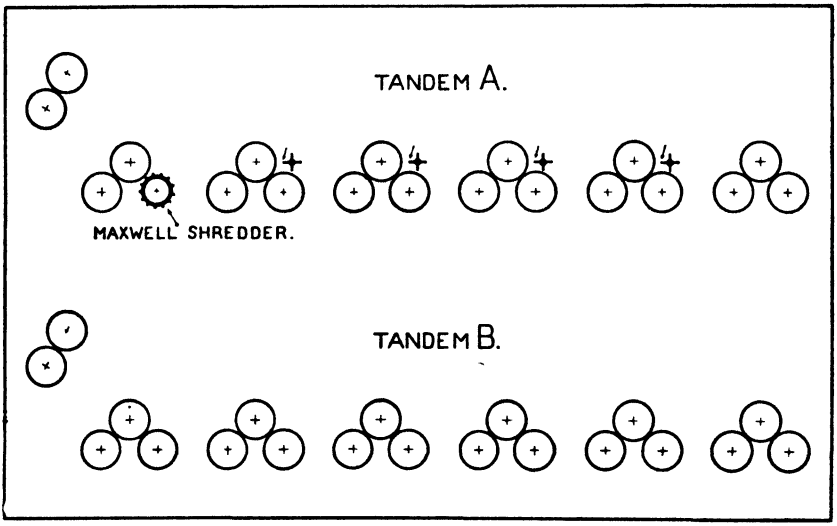


FIG. 1.

Both tandems A and B are practically identical in all respects except for the alteration made in the first mill of tandem A (the other additional changes will be discussed later). This primary alteration consists, simply and solely, of removing the bagasse or discharge roll of this mill and putting a Maxwell shredder roll into its place. It is clear that this method of converting an existing mill into a Maxwell patent crusher-shredder entails no alterations whatever, either to the mill or the carrier; the shredder roll, together with its bearings, being easily slipped into the gap previously taken up by the bagasse roll, as is demonstrated in Fig. 2.

The shredder roll is independently driven and rotates at a fairly high speed; at Espana about 400 r.p.m. The action upon the cane by this cane preparatory machine is readily conceived by reference to Fig. 2. As the cane enters this unit, it is gripped and crushed between the top and feed rolls and forced through the passage between the top roll and the trash turner plate. As the compact mass slowly emerges, while thus still being held tightly, it comes into contact with the swiftly revolving teeth of the shredder

[1] See Cuba Sugar Club Report, 1925 (Milling Equipment).

and is thereby " teased " or " combed " into fine shreds. This perfect process of shredding is most fully appreciated only by actually standing near the machine and watching the fine shreds issue forth in a constant and uniform spray and settle down on the carrier in such a thoroughly prepared state as to arouse the envy of mill engineers. Prior to entering the next mill, this fairly voluminous blanket of bagasse shreds is conveniently pressed down by a " press roll " and reduced to a suitable thickness, ensuring an even, smooth and regular feed and consequently getting rid of choking. This phase will be discussed later.

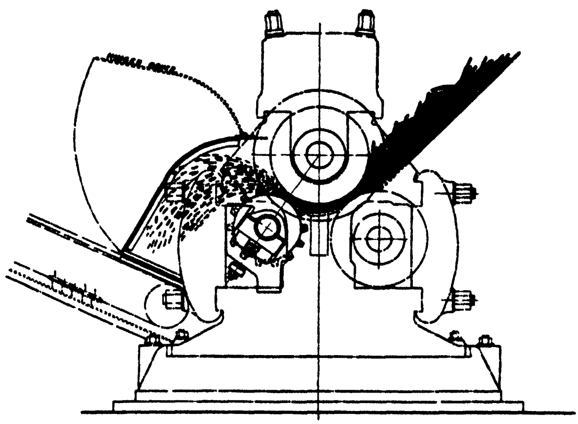


Fig. 2.

The Maxwell Shredder.—The shredder device, named after the inventor, Dr. Francis Maxwell, of London, was made and installed at Central Espana by the Farrel Foundry & Machine Co. of Ansonia, U.S.A., and one may be allowed to add that it is a first-class piece of work, as is unanimously confirmed by the sugar engineers who have examined and watched it in operation.

The Maxwell patent shredder at Espana consists of a hollow steel roller of 30 in. × 84 in. size, designed to work in a mill with 36 in. × 84 in. rollers. In its construction and principle of operation the Maxwell shredder is completely different from any other shredder hitherto known to the cane sugar industry. A great number of individual teeth of particular design are arranged at a certain pitch in series or rows. The shredder under consideration has 13 rows, with 34 teeth to each row, thus a total of 442 teeth to the roll (see Fig. 3).

The design and arrangement of these teeth are such as to produce a " combing " or " teasing " action upon the blanket of cane; they are not " grinding " or " beating " surfaces. The production of bagasse dust or bagacillo, inevitably attendant upon modern shredding, is consequently reduced to a minimum. The teeth are made of special steel with a view to providing a keen and lasting cutting edge, combined with strength to withstand iron bodies that may happen to pass through the shredder (see Fig. 4).

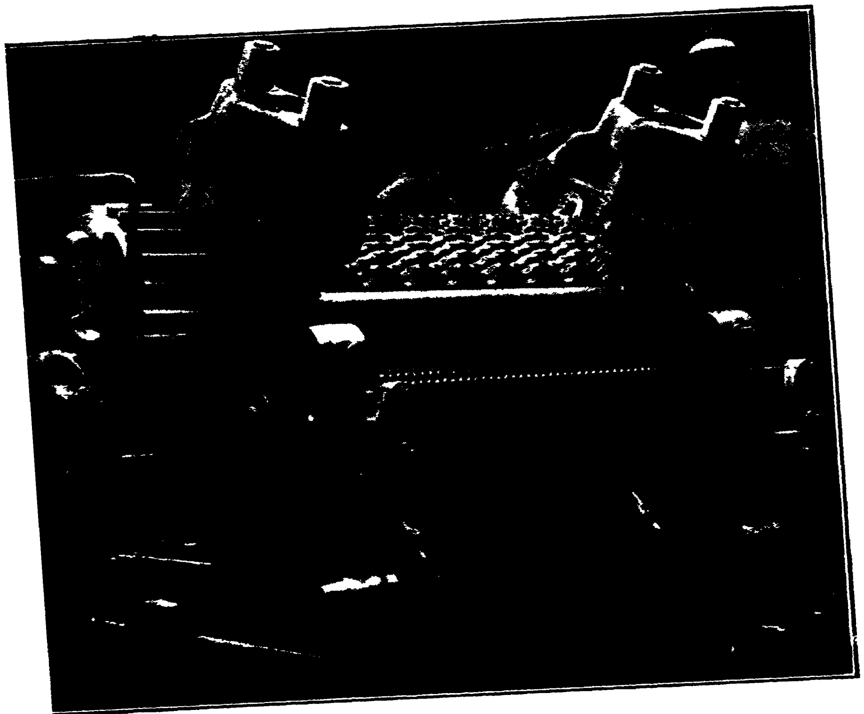
It will be observed that these teeth have a double cutting edge, so that they can be reversed when one side gets blunt. The teeth are fixed in slots in such way as to allow the individual teeth to be easily and quickly replaced or reversed.

The teeth—or generally speaking, the cutting elements—of shredders have always presented a cardinal problem. We read[1] that when Dr. Maxwell demonstrated his experimental crusher-shredder in Java in 1924, the leading mill engineers of that island, while fully appreciating the extraordinary results achieved, at the same time expressed their doubt as to whether the

[1] *Facts about Sugar*, March 5th, 1927.

Fig. 3.

The Maxwell Milling System.



MAXWELL PATENT CRUSHER-SHREDDER
Size 32 in. × 66 in., supplied to Natal, South Africa

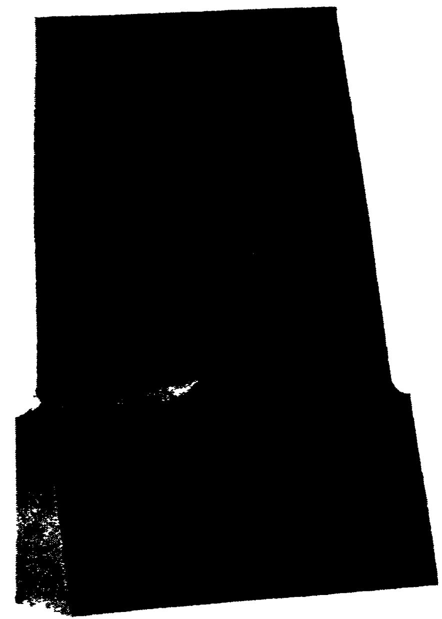


FIG. 4.

teeth would last for any length of time. This vital point has now been settled, once and for all, at Central Espana. In this factory, after the shredder had run for 42 days and had shredded roughly 120,000 tons of cane,[1] a close examination of the teeth was made. It was found that no more than five teeth out of 442 had been broken off through contact with iron bodies. About a dozen were slightly chipped, their shredding efficiency being, however, unaffected. The cutting edge of all the teeth was virtually unimpaired, being only imperceptibly blunted. But the most telling proof, after all, of the lasting quality of the teeth is that up to the date of writing this paper, over 200,000 tons of cane has gone through the shredder and the original teeth are still operating; none have been replaced, re-sharpened or even reversed.

Prior to the installation and operation of the Maxwell crusher-shredder in Cuba, fear had frequently been expressed that if iron bodies happened to go through the shredder—which, by the way, does not appear to be an uncommon experience in Cuba—they would simply play havoc with the teeth. This fear has proved to be groundless, as all kinds and sizes of iron passed through the shredder while the latter continued to hum merrily.

FIG. 5.

Some interesting samples have been collected at Espana, of which the accompanying two illustrations will give a fair conception of what the Maxwell shredder has coped with.

Fig. 5 shows a part of a steel carrier slat ½ in. thick, which somehow got bent and came into contact with the swiftly revolving teeth, which gave it the appearance of a wild goose feather. No damage was done to the teeth. In Fig. 6 is shown a crow-bar that accidentally went through the shredder. This iron bar was 18 in. long, 1¼ in. diam. and 3 in. broad at the flat end. The deep gashes, visible on the photograph, afford a grim proof of the quality of the shredder teeth. As already stated, after shredding over 200,000 tons of cane, and in spite of the frequent passage of bolts, chain links, and even crow-bars, the Maxwell crusher-shredder continues to operate with the original teeth, without any having been replaced, sharpened or reversed.

Coping with heavy capacities.—In Cuba, previously, whenever the subject of shredders was broached, the question inevitably arose whether any shredding device could cope with the huge grinding capacities obtaining in that island. It is well known that once a Cuban Central starts grinding, the

[1] Quincena Report of Central Espana, 16th February, 1927.

primary consideration is to keep it going at all costs, day and night, throughout the crop with the least possible time lost in stoppages. It is obvious to any mill engineer that such a state of affairs demands extraordinary qualities of the milling plant, especially when a shredder is in question. It is, therefore, hardly surprising that while shredders of one kind or other have been in operation in countries such as Hawaii, Java and Queensland, not a single shredder was operating in Cuba when the present installation was made at Espana.

It has now been definitely proved in operation that the Maxwell patent shredding device can cope with any capacity of grinding. It was established at Central Espana that the rate of grinding was simply governed by the quantity of cane the preceding crusher could deal with, and that the shredder roll will look after itself. Indeed, it was observed that the heavier the feed, the finer the shredding. As for the subsequent mills, the finely and uniformly shredded mass ensures a more regular and smoother running. It was particularly noticeable at Espana that choking of the mills in Tandem A dealing with the shredded mass was practically absent.

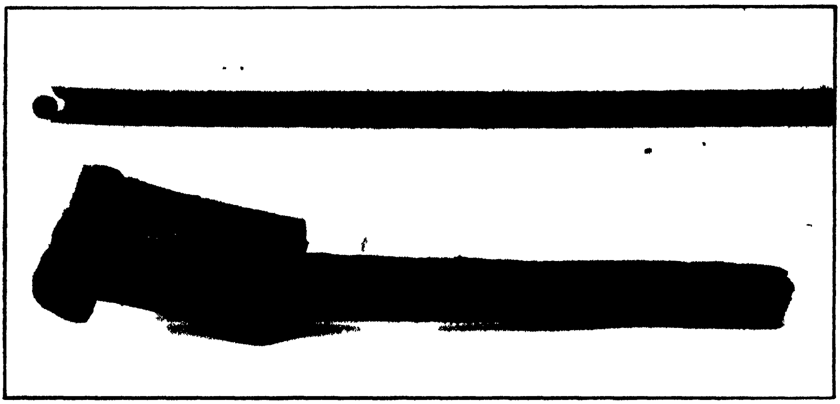


FIG. 6.

Consumption of power.—Another cardinal factor in considering the economic value of a shredder—or any machine for that matter—is, of course, the power required to drive it. Since the Maxwell shredder at Espana is driven independently by a motor, the automatic recording ammeter indicated accurately the power consumed. The 30 in. × 84 in. shredder roll required an average of 70 to 80 h.p. at a shredding rate of 135-150 tons of cane per hour, or roughly 3500 tons of cane per day. This extraordinarily low consumption of power by such a large size shredder working at such enormous capacity has been rendered possible by the principle upon which the Maxwell invention is based.

Results.—However interesting the foregoing information may be, to the practical sugar man the criterion of economic success for a machine of this kind is, of course : *results*, in ultimate terms of cash saved. Before, however, coming to the £ *s*. *d*. question, it is well to discuss one or two contributory factors.

1. Preparation of Cane : The benefit of shredding, when properly carried out, is not open to doubt. The yield of juice is definitely increased and the extraction of sugar correspondingly raised. The gain will, of course,

vary according to the efficiency of the milling equipment which succeeds the shredder and completes the work.

The character of the shredding performed at Central Espana is easily discerned in Fig. 7. With a view to enabling the reader to form a comparison, the accompanying photographs, taken on the spot, are given. Fig. 7 shows two piles of bagasse; the left coming from the Maxwell crusher-shredder in A Tandem, and the right from the first mill of B Tandem, both units holding equal positions in the respective tandems. The following should be read with reference to Fig. 1. A far more interesting comparison is given in Fig. 8.

In this photograph the pile on the left hand side represents the bagasse coming direct from the crusher-shredder in A Tandem, while that on the right is bagasse coming out of the 3rd mill of B Tandem. Thus, so far as the physical preparation of the cane is concerned, it will be observed (see Fig. 8 in conjunction with Fig. 1) that the crusher plus the mill-shredder

FIG. 7.

in Tandem A do the work at least equally as well as the crusher plus *three* mills in Tandem B. Since the photograph is an enlargement, it may, perhaps, not afford such a clear comparison, but the fact is brought home in a striking manner on the spot by simply crossing the platform connecting the Tandems A and B. It must be borne in mind that we are comparing here the physical nature of the bagasse. From the above comparison it is evident that in the case of Tandem A the five mills following the crusher-shredder become purely pressing, wringing or "mangling" units, being freed from the duty of breaking down the fibrous structure of the cane, whereas in Tandem B only the three mills following the third mill can claim to be solely pressing or mangling units.

The importance of the crusher-shredder in this respect is that at the outset the directly following mills which receive the shredded cane secure more juice with less power, and, moreover, the maceration is more thorough and efficient throughout the tandem. This subject of maceration will be discussed further on.

2. Extraction Results: Since at the time of writing, Central Espana is only part way through its grinding season, the only available data refer to the

early part of the crop, and should be considered as preliminary information. It may be at once stated that Tandem A, comprising the crusher-shredder, has throughout given results consistently better than Tandem B. In this regard, attention is particularly drawn to the fact that Tandem A is minus a juice extraction unit, namely, the bagasse roller of the first mill, which has been replaced by a purely shredding element. Next season the bagasse roller will be put in its place again and the shredder roller fixed on top of the mill, thereby creating the proper Maxwell *mill-shredder* consisting of three mill rollers plus a shredder roller. According to the daily reports[1] (8th to 12th February, 1927), the figures for extraction (sucrose in juice per cent. sucrose in cane) of Tandem A varied from 95·05 to 95·59, the per cent. sucrose in the bagasse from 2·59 to 2·89 and the per cent. moisture in the bagasse 47·81 to 48·43, the maceration (per cent. cane) from 17·28 to 21·01 and the amount of cane ground per hour from 125 to 143 short tons. The proper value of these figures will be readily appreciated by comparing them with the respective data of other Cuban Centrals appearing in the reports of the Cuba Sugar Club.

FIG. 8.

As to a comparison between Tandems A and B, taking a 15 days' run,[2] the average extraction of A Tandem was 95·05 and of B Tandem 94·45, thus a difference of 0·6 in favour of A, but at times this figure has risen to 1·5 per cent. The other figures of Tandem A are correspondingly superior. In considering these data of Tandem A, it must be borne in mind that the operation of the shredder is a new practice in Cuba and that shredded cane requires different settings of the mills which involved the method of trial and error before the final openings are successfully obtained. Therefore, it may be confidently anticipated that with experience, results which will finally be published will show a greater improvement.

The Maxwell mill-shredder.—That the results achieved by the present installation at Espana are regarded as a success is evident from the fact that the Farrel Foundry & Machine Co. are now busy making a 4-roller Maxwell mill-shredder to be installed in this Central for next season. It will consist

[1] The following data have been derived from daily and semi-monthly reports issued by Central Espana. [2] Quincena Report Espana as supplied to the Cuba Sugar Club.

of an ordinary 3-roller mill with a Maxwell shredder attached on top and co-acting with the bagasse roller, as is shown diagrammatically in Fig. 9.

As compared with the present method of applying the Maxwell shredder (see Fig. 2), it is clear that the proper 4-roller mill-shredder will be a superior cane preparatory unit, since not only more juice is extracted by the extra roller, but the shredding of drier bagasse will also be more effective, especially with a view to more thorough maceration.

The remainder of the Maxwell Milling System.—The universal method of applying maceration or imbibition used in cane sugar countries, except in Queensland where maceration baths are used, consists, as we know, of allowing the fluid (be it juice or water) to spray down on to the blanket of bagasse. The same method is commonly employed in Cuba. But whereas the blankets of bagasse in other countries vary in thickness, say 5 in. to 7 in., in Cuban Centrals of large capacities it is about double the thickness. For instance, at Central Espana, grinding at the rate of 140-150 tons of cane per hour, the blanket of bagasse averages about 12 in. thick, gradually diminishing to 11-10½ in. at the last mill. Does it not stand to reason that

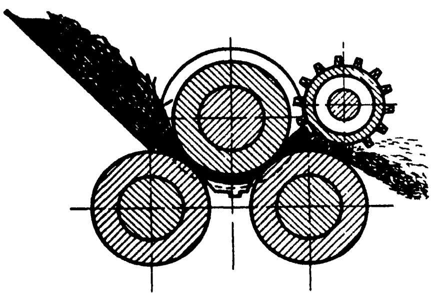


Fig. 9.

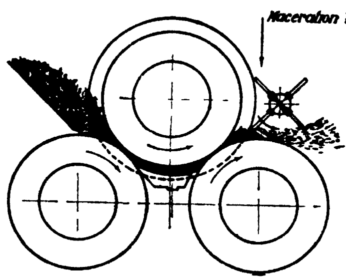


Fig. 10.

spraying liquid on to such a thick blanket will not allow the maceration medium to penetrate deeply, as it is readily absorbed in the upper surface (which is especially the case with a shredded mass). We learn[1] that Dr. Maxwell demonstrated at Espana that the average penetration with the old method was not more than about 3 in. from the surface of the blanket. This was readily shown by pouring a solution of milk-of-lime on the bagasse emerging from the first mill and following the yellow mark which it produces on the bagasse through one mill after another to the end, while testing by hand the moisture of the upper and lower layers of the bagasse from time to time. In order to induce the macerating liquid to penetrate more deeply, a roller is sometimes applied against the discharge roll with a view to pressing the liquid into the bagasse by force. It is, however, clear that the greater the pressure thus applied to the blanket of bagasse, the more compact and more impervious it becomes to penetration by a fluid. Indeed, in the case of shredded bagasse it has been found in other countries that the blanket under great pressure assumes approximately the nature or texture of cardboard. Dr. Maxwell's method adopts the reverse principle of separating or scattering the bagasse instead of compressing it.

The Maxwell "Macerotor."—This patent consists of a shaft provided with a series of fingers, placed on the top of the mill between the top roller and the discharge roller, thus occupying a position on subsequent mills corresponding to that of the shredder roll in a 4-roller mill-shredder. The "Macerotor" is driven by an independent motor and rotates about 200 r.p.m. It co-acts with the bagasse roller and the fingers approach very

[1] *Facts about Sugar*, 5th March, 1927.

closely to the top roller. As the blanket of bagasse emerges from each mill, the fingers of the "Macerotor" violently scatter it, while the maceration liquid which pours down practically simultaneously in between the "Macerotor," and the top roller is beaten into, as it were, an atomatized state, resulting in the most intimate and intense absorption of the liquid by the scattered shreds, as shown in Fig. 10.

Dr. MAXWELL'S invention,[1] simple as it sounds, is nevertheless of a revolutionary nature, as will be appreciated by mill engineers. The age-long slogan of "Don't disturb the blanket" is thereby exploded. The novelty and originality of Dr. MAXWELL'S macerating system is proved by his being granted basic patents[1] in all cane sugar countries applied for.

At the time of writing only one "Macerotor" had been installed, namely on the fifth mill. Its initial operation achieved extraordinary results. It appears that the whole amount of macerating water, over 20 per cent., could be applied at the fifth mill, and an expert present expressed his opinion that double the quantity of water could easily be absorbed by this method. The surprise was that no slipping or choking occurred at the last (sixth) mill. Since only one of the four Maxwell "Macerotors" is as yet (at the time of writing) in operation, it would be premature to discuss their results as a whole. Final figures and data, however, will be published at the end of the Cuban grinding season.

Financial results.—The above exposition of the Maxwell milling system may, or may not be, interesting, but, after all, to the practical sugar man there is ultimately one, and one only, question : "What is the result translated in £ *s. d.* or $?" It is therefore, proposed to wind up this paper with an attempt to "produce the goods."

We may begin by taking it as proved and granted, even basing ourselves on the preliminary data at our disposal, that the new system of milling will save at least 1 per cent. of sugar, which would otherwise be lost in the furnaces. Indeed, the writer, believes that the Farrel Foundry & Machine Co. will, in the near future, be prepared under certain conditions to *guarantee* this saving by the installation of the Maxwell milling system.

Now, taking, for instance, a Central turning out say 70,000 tons of sugar per annum, 1 per cent. would make 700 tons extra sugar recovered. Of course, this extra amount gained involves certain relative expenses, of manufacture, sugar bags, etc., but since this additional amount of sugar would be recovered simultaneously with the bulk of the output, the extra expenses are practically a negligible factor. However, taking the trifling extra expenses into account, we think it is a fair figure, at the present prevailing market price, to put the nett profit gained at say 3 cents a lb. or $60 a ton (of 2000 lbs.). The saving of a Central such as that under consideration would, therefore, be 700 × $60 = $42,000 per annum, or roughly £8500 per annum.

The above example, however, is based on an extra recovery of 1 per cent., whereas the opinions expressed by leading engineers, who have witnessed and carefully examined the Maxwell system in operation, agree that, once the mill engineer acquires by experience greater familiarity and greater competence in the manipulation of this entirely novel method of milling (especially in the tuning up of the mills), there is no reason why 2 per cent. extra recovery should not be attained. This would imply on the above basis a saving of $84,000 or roughly £17,000 per annum.

Of course, the figure for extra recovery will vary widely according to the magnitude and quality of the existing milling plant, and also according to the original figure of extraction to be improved upon. It stands to reason that, under similar conditions, it is much easier to increase say an extraction

[1] See page 226.

(or corresponding recovery) of 93 per cent. to 95 per cent. than say 95 per cent. to 97 per cent.; or in other words, the higher the original figure, the smaller the additional gain will be.

Considering, however, that apart from Cuba an extraction figure of 93 per cent. and lower is very commonly met with in other cane sugar countries, excepting the Hawaiian Islands, it will be appreciated that there is considerable scope for the Maxwell system of milling.

That the economic success of the new milling process is finally established is demonstrated practically by the fact that up to date at least two new Maxwell mill-shredders are being made by the Farrel Foundry & Machine Co. for the next season in Cuba; while a Maxwell crusher-shredder, made by the same firm and installed at Central San Francisco, in Porto Rico, had its initial operation this season, giving results to the entire satisfaction of the owners. Furthermore, it is learned that a Maxwell crusher-shredder, made by the Sugar Machinery Mfg. Co., of London, is at present being erected at the Umfolozi Mill, in Zululand, South Africa, which will shortly start operating.

Note on the Determination of Dirt Tare on Sugar Beet Consignments.

By WM HICKSON.

At the termination of the beet campaign there is often found to exist a considerable discrepancy between the weight of beet passed through the factory as recorded by the automatic weighing machines and that calculated from the tonnage passed over the weighbridge on the basis of "dirt tares" as estimated on average samples in the laboratory. The fact that the former weight is invariably the lower, appears to indicate a general error in the "dirt tare" determinations.

The amount of water absorbed by and adhering to samples after washing has not been properly considered, but the following experiments indicate that herein lies the solution, or, at least, a factor which will meet and to a large extent cover the losses in a legitimate manner. Samples used for "dirt tare" determination are either 28 or 56 lbs. in weight. These are cleaned in washers of various forms; and, after any necessary re-topping, are re-weighed. The difference is recorded as pounds per cwt. with no allowance for acquired moisture.

Experiment 1.—A sample of roots was carefully cleaned by dry-brushing. 28 lbs. were accurately weighed and placed in a washer for 3 minutes. After withdrawal from the washer the roots were given a short period for draining (corresponding to that received by samples in routine practice in connexion with re-topping) and were found on re-weighing to have gained 6 ozs. This equals approximately 1¼ per cent *or* 1½ lbs. per cwt.

Experiment 2.—A sample of 56 lbs. of roots was treated similarly to above and was found to have gained 1½ lbs. in weight. This equals approximately 2½ per cent. *or* 3 lbs. per cwt. The average of these two experiments equals approximately 2 per cent.

Undoubtedly the water-absorptive property of sugar beet is very variable, but, after taking into account the slight lowering of the sugar content value, it is probable that a fair adjustment would be 1 per cent. Thus a factory paying for 100,000 tons of beet under the present system (roots being paid for in accordance with estimated "dirt tare") would save the equivalent of 1000 tons of raw material.

Note on the Determination of Sugar in the Beet, and on the Use of the Krüger Method.

By ARM. LE DOCTE.

With much surprise I have recently read that the so-called Krüger method is still being recommended for the determination of sugar in the beet, although 25 years ago Mr. SACHS and the writer showed that this method of working is altogether open to criticism, and should be left alone entirely, as will be seen further on. But a few retrospective words are here necessary.

EVOLUTION OF THE SACHS LE DOCTE METHOD.

It was in Belgium (where sugar manufacturers first bought roots according to their sugar content) that Pellet's hot aqueous digestion method was first put into operation, then later the same savant's cold procedure, both being applied with the use of glass graduated flasks. The cold process was immediately adopted by reason of its great facility and rapidity of execution, but in practice it was found that it included a serious source of error, this arising from the considerable amount of air which was entangled in the fine pulp, which air altered the true volume of the liquid in the graduated flask. In spite of the use of alcohol, ether, and of all kinds of artifices (including the pneumatic pump), which deprived the method to a great extent of its advantages of simplicity and rapidity, it was extremely difficult if not impossible to get rid of this source of error.

About this time, i.e., in 1892, Mr. KAISER, a German sugar manufacturer, conceived the idea of doing away with the graduated flask, simply adding to the normal weight of fine pulp a certain quantity of water and of lead subacetate, the volume of which was to be determined. He communicated this idea to his young friend, Mr. LOEWENBERG, then pupil at the Frühling and Schultz Institute, Brunswick, asking him to conduct some experiments to test it, and a little time after in the German sugar journals a note appeared pointing out that it was possible to determine sugar in the beet by cold aqueous digestion without using a graduated glass flask by operating in the following way : Weigh the normal weight of pure pulp in the dish habitually used with the graduated glass flasks ; introduce this into a glass vessel of about 200 c.c. capacity ; wipe out the dish with a piece of filter-paper ; introduce this also into the vessel ; add 5 c.c. of lead subacetate solution and 72 c.c. of water (or 77 c.c. of a mixture of the two made in advance) ; mix with a glass rod ; allow it to remain for 20-30 min.; then filter and polarize in the 200 mm. tube. In place of the glass vessel, one could also employ a glass flask having a wide neck with a ground-glass stopper, this permitting one to mix more energetically and more completely by shaking than with a glass rod. As to the proportion of water and reagent, this resulted from the following calculation : According to tests made in this direction, the beet contains on the average 4·75 per cent. of mark, that is, 1·24 for 26 grms., leaving 26·00 — 1·24 = 24·76 grms. of juice. Assuming a density of 1075 for this juice, corresponding to a sugar content of 15 per cent., these 24·76 grms. of juice represent 22·98 c.c., say 23·0 c.c.; therefore by adding 77 c.c. of liquid one obtains 100 c.c. exactly, which contains all the sugar in the 26 grms. of pulp.

This note passed almost unperceived in Germany, but *in embryo* it was a method calling to be investigated, controlled, and rendered practical for

the execution of a large number of analyses daily. Its principle was alluring and its realization was of considerable interest to Belgium. In consequence, two engineer-chemists, Fr. Sachs and the writer submitted it to a very exact study, which was carried on for more than a year. It resulted that for the application of the principle everything had to be modified, the following two indications in particular being entirely abandoned : (1) The proportion of 100 c.c. to 26 grms. of pulp, because this proportion did not make it possible

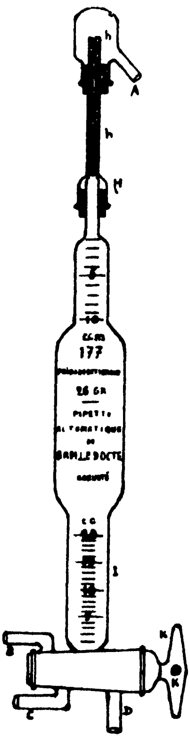


Fig. 1.

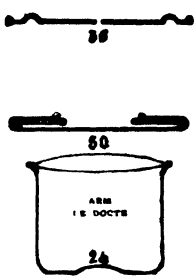


Fig. 2.

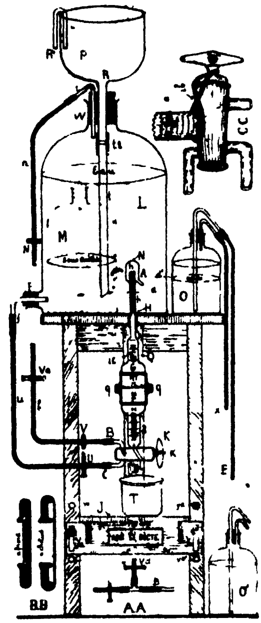


Fig 3.

without leading to too great errors to deviate sufficiently from a sugar content of 15 per cent. serving as base ; also because the amount of liquid was insufficient to assure a regular admixture with an immediate and complete diffusion of all the sugar, and was insufficient to give enough solution for the use of the Pellet continuous tube. (2) Admixture by means of the glass rod was uncertain, while the use of the glass stoppered flasks, though giving a certain admixture, was also to be rejected owing to the difficulty of drying them inside, the trouble of always replacing the correct stopper, and the frequent breakages. Only one of Loewenberg's indications remained, namely, the basis for the calculation of the liquid to be added, viz., 4·75 per cent. for the mark, 15 per cent. for the sugar content, and a density of about 1075 for the juice. All the practical manipulative points, and all the material necessary were minutely studied in their smallest details, and there finally resulted the "Sachs Le Docte" method, so baptized with the assent of Messrs. Kaiser & Loewenberg, and demanding the following

rigorous prescriptions, each having their value and none to be omitted or modified.

Quantity of fine pulp, 26 grms., and volume of solution to be added, 177 c.c. Pulp weighed directly in tinned brass capsules (see Fig. 2) all counterpoised to the same uniform weight, viz., 75 grms., thus requiring only one weight, these capsules having a volume of 325 c.c., and a diameter of 78 mm., dimensions and form permitting easy and rapid weighing, admixture complete and immediate, and rapid draining after washing. Use of 1 c.c. of lead subacetate (at 30° Bé.) per 5 grms. of pulp, that is, 5 c.c. per 25 grms. Addition to the capsule of 177 c.c. of solution (5 c.c. of lead solution and 172 of water) by means of a pipette (Fig. 1) automatically filling and emptying exactly gauged to 177 c.c., permitting the use at will either of a mixture made in advance of lead subacetate and water in the proportions above indicated, or of water and reagent separately measured, and providing also for increasing the proportion of reagent in the mixture made in advance, when in special cases that may be necessary. Closing of the capsules by a simple disc cover having a rubber cap, this being applied successively to all the capsules without necessitating any rinsing, and forming with all a hermetic joint so as to permit energetic agitation assuring an absolutely perfect mixture with the complete diffusion of the sugar in less than 5 seconds. Filtration immediately if desired, or if not the transfer of the lid to the next capsule, covering the treated capsule with a glass or perforated aluminium disc to prevent evaporation. Filtration through a 21 cm. paper folded simply into four placed in a funnel without stem, 11 cms. in diam., directly into a glass cylinder of 250 c.c. with lip ; contents of the capsule poured at once entirely into the filter, placing over which the perforated disc for recovering the capsule to avoid evaporation during the filtration. Polarization in the Pellet continuous tube, 400 c.c. long, after addition to the filtrate of a drop of concentrated acetic acid, the polarization indicating the quantity of sugar per 100 of roots.

Mr. SACHS presented this method to the Société Belge des Chimistes in 1894, and in the following year Mr. ARM. LE DOCTE published his first brochure giving all details of his procedure, the apparatus to employ, and their manner of use. This process and its apparatus were experimented with in all the agricultural laboratories in the State, and the results were so satisfactory in all reports, and so concorded with those given by alcohol extraction (the scientific process *par excellence*) that the method was everywhere adopted for the commercial determination of sugar in the beet. Some years after, that is 20 years ago, it was adopted by the Belgian Government as their Official Method, and specified for the determination of sugar in the beet in transactions between beet farmers and sugar manufacturers. No other method could be employed in Belgium for such business. Since its initiation, it has naturally extended throughout the whole world, *and it is employed everywhere just as it was proposed in* 1894 *without it having been necessary to make a single modification.*

APPEARANCE OF THE KRÜGER METHOD.

But subsequent to 1894 there appeared in Germany the Krüger method[1] pretending to perfect and simplify the Sachs Le Docte process then applied in numerous sugar factories in Germany, Austria, Bohemia, Russia and elsewhere. German pride, no doubt, was humiliated in finding that the S.L.D. process (a German idea) had not remained completely and exclusively German. Anyway, the "improvements and simplifications" claimed related to the following points : (1) The Krüger device required a pipette

[1] *Deut. Zuckerind.*, 1896, 2434.

not having a fixed and determined volume, and its operation was quite difficult, and in consequence more costly. (2) It did not require counterpoised capsules all of the same weight. (3) It did not require any cover to be applied to the capsules to effect the admixture. The novel arrangement comprised the following : A pipette of any volume near 70-80 c.c.; a quantity of pulp equal to one-third of the volume of the pipette ; weighing of the pulp on pieces of paper all practically the same weight, these pieces of paper being transferred to a metallic capsule. After addition by means of the pipette of a mixture of lead subacetate and water made in advance, there followed agitation by means of a glass rod, then, after setting aside for 20 mins., filtration.

It was observed immediately that the Krüger method reverted to almost all Loewenberg's primitive indications, recognised as defective, the only one of these exact and worth retaining, viz., the calculation of the volume of the liquid, now being replaced by another completely false. This meant that the entire description of the Krüger method was to be rejected altogether, no point excepted.

(1) In the first place there was the arbitrary volume of the pipette and the weight of pulp variable according to volume, differing according to the type of polarimeter, and differing even in the same laboratory if several pipettes were in operation at the same time. This certainly was an arrangement absolutely inadmissible, and strongly to be condemned especially in respect of commercial analyses, being provocative of frequent errors favouring fraud.

(2) Next there was a weight of pulp equal to one-third of the volume of the pipette, a proportion that in general appeared inviting, but which was entirely wrong. This proportion corresponded, for a normal weight of 26 grms., to a volume of liquid of 78 c.c., forming the base for application to all sugar contents from the lowest to the highest. And this base of 78 c.c. corresponded to a root having juice of a density of 1125, that is about 22 per cent. of sugar. Consequently the differences between the Krüger method and the exact content, errors which therefore are always committed, are the following : With beets of 20 per cent., 0·10 ; of 18 per cent., 0·13 ; of 16 per cent., 0·15 ; of 14 per cent., 0·16 ; and of 12 per cent., 0·17, errors evidently inadmissible. Now, with the S.L.D. method, the base of which is 1075, that is a sugar content of 15 per cent., and a volume of liquid of 177 c.c. for 26 grms. of pulp, the deviations from the exact content are always negligible, almost nil, in fact. Thus with a beet having 20 per cent., 0·05 ; 18 per cent., 0·025 ; 16 per cent., 0·00 ; 14 per cent., 0·01 ; and 12 per cent. 0·02 per cent. As the weight of the mark, 4·75 per cent. is admitted ; and if exceptionally the proportion of mark should rise to 7 per cent., for example, the error thereby occasioned would be 0·035 per cent. of sugar with the S.L.D. method but 0·075 with the Krüger process.

(3) The volume of liquid to be added to 25 grms. of pulp, viz., 78 c.c., giving results always inexact as has been indicated above, was still on the other hand to be rejected for the following motives : The quantity of liquid was too small to obtain a perfect admixture immediately, and a complete diffusion of all the sugar. It was also too small to obtain rapidly by filtration a sufficient quantity of filtrate for use with safety with the Pellet continuous tube.

(4) The weighing of the 26 grms. of pulp on a piece of paper required more time and much more precaution and attention than direct weighing

into the tared capsule of the S.L.D. process. Moreover, it necessitated a supplementary operation, namely the transfer of this piece of paper with the pulp into the capsule, this giving rise to accidents, necessitating recommencing the weighing. Again, the presence of the piece of paper in the capsule, besides the small quanity of liquid, nullified the regularity of the admixture and of the agitation with the glass rod, and lastly during filtration the presence of this piece of paper hindered the transfer of the contents of the capsule into the filter.

(5) Admixture of liquid added and of pulp in the capsule by means of a glass rod should always and in all cases be entirely prohibited (even in the S.L.D. method in spite of the large volume of liquid, as is sometimes done, contrary to the formal directions of the method), as it was altogether insufficient even if it is done several times at different intervals. It is especially insufficient in the Krüger method with its small amount of liquid and in presence of this piece of paper.

The conclusion to be drawn from these remarks is the opinion formulated at the start, that is to say, that it is regrettable to still see urged in technical publications a process so inexact and so open to criticism on all points of view as the Krüger method. which thus compels refutations already made 25 years ago.

Behaviour of Solutes during Char Filtration.[1]

By E. W. RICE and G. W. MURRAY, Jr.
National Sugar Refinery, Yonkers, N.Y.

None of the published data on adsorption by carbon of various types[2] is based on percolation through bone charcoal of refiners' grades. Accordingly, the adsorptive power of high-grade refiners' bonechar of about 8 per cent. carbon, acting on aqueous solutions containing 2 grms. per 100 c.c. of various substances which might be present in raw sugar, was determined as a preliminary to further investigations.

Solutions of " tested purity " chemicals were percolated upward through 15 in. of char (300 c.c.) at the rate of 1 ft. per hour, which delivered 150 c.c. per hour, five 50-c.c. portions being caught and analysed, and the temperature kept at 77°C. A conductivity apparatus was used for all the analyses, except the sucrose and invert sugar determinations, the polarization of the sucrose, and the polarization and copper precipitation of the invert sugar. The resistances of the filtered portions were determined in a conductivity cell and the conductivity was calculated, the conductivity of distilled water which had been passed through a check-filter being deducted from this. The amount of salt present was determined by quantitative dilution of the original solution to a conductivity equivalent to the corrected conductivity. Enough ammonia to give marked conductivities is worked out of the char by the first portions.

The data on invert sugar here reported were obtained on a commercial product containing reversion products and it will be seen that the polarization does not check with the copper reduction percentages. Nevertheless, it is interesting to note that at first the levulose was adsorbed to a much greater extent than the dextrose while later the reverse was apparently true. The

1 Presented before the Division of Sugar Chemistry at the 72nd Meeting of the American Chemical Society, Philadelphia, Pa., 1926.

2 Osaka, *Mem. Coll. Sci., Kyoto Imp. Univ.*, 1915, 1, 257.

results in the accompanying table are given in the order of maximum adsorption in the first portions, except those for sucrose and invert sugar.

The difference in adsorption is so great that any seeming inconsistencies do not materially influence the value of the results. Various unknown factors make it seem that the method of analysis was sufficiently accurate. The amount of water adsorbed by different grades of char will vary largely with the apparent adsorption of the salts. The fact that char will adsorb substances at one concentration and give them up at another, which has been proved before, was shown in several filtrations of a raw sugar solution through a 64 ft. column of char. The invert sugar in the first portion of one solution was 0·63 per cent.; in later portions it rose to 1·56 per cent. and finally dropped back to 1·29 per cent., the original percentage in the solution.

SALTS IN SUCCESSIVE PORTIONS OF BONECHAR—TREATED SOLUTIONS.
(50 c.c. portions analysed).

Sample	Calcium phosphate Per cent.	Sodium carbonate Per cent.	Sodium sulphate Per cent.	Calcium acetate Per cent.	Sodium citrate Per cent.	Calcium chloride Per cent.
Original Solution.	2·00	2·00	2·00	2·00	2·00	2·00
1	0·03	0·08	0·16	0·27	0·60	1·42
2	0·04	0·40	0·68	1·40	1·80	1·86
3	0·05	0·92	1·60	1·98	1·98	1·90
4	0·06	1·40	1·80	2·04	2·04	1·90
5	0·07	1·60	1·80	2·40	2·40	2·02

Sample	Potassium nitrate Per cent.	Sodium chloride Per cent.	Sucrose Per cent.	Invert Sugar Per cent.	Polarization for Invert Sugar °V.
Original Solution.	2·00	2·00	2·00	1·44	—1·15
1	1·48	1·98	0·84	0·57	+1·60
2	1·88	2·06	1·90	1·08	+1·00
3	2·26	2·06	1·95	1·24	+0·40
4	2·26	2·06	1·98	1·30	—0·10
5	2·26	2·06	2·00	1·36	—0·60

There is undoubtedly exchange adsorption between the solutes and the char, and also among several substances adsorbed at one time. Hence the analysis of the portions already off may vary largely from that of the portion coming off, especially when a refiners' char containing many chemical substances is used. The refiner's chief question is not about the composition of the filtered material but about the effect upon crystallization of the sucrose by the quantity of other substance present in solution. It is apparent that complete purification of raw sugar is practically impossible by use of bone-char alone.

The motor-spirit distillery opened at the Mehta sugar factory, near Kampala, Uganda, has an estimated output of 125,000 galls. a year, to be retailed at 2s. a gallon.

THE GREAT WESTERN SUGAR CO. puts forward to beet growers and field workers the following 14 points for improved yields, 20 tons per acre at the present time being by no means unusual: (1) Fertilization with barnyard manure or turning under leguminous crops; (2) rotation, the proper sequence of sod, grain and inter-tilled crops; (3) improved preparation of seed-beds: (4) early planting at the proper depth; (5) irrigation of beet plantings to germinate the seed in the absence of natural rainfall; (6) prevention of crust in early stages of crop growth; (7) closer spacing in the rows, an average of 12 ins. between plants; (8) leaving the big healthy seedling in the thinned stand; (9) close supervision by the farmer of the hand labourers at blocking and thinning time; (10) early thinning; (11) frequent cultivation; (12) light and frequent irrigations; (13) education of the hand workers; and (14) co-operation of landowners on tenant farms.

Publications Received.

Industrial Furnaces. W Trinks. Volumes I & II. (Chapman & Hall, Ltd., London) Price : Vol. I. 22s. 6d ; Vol. II. 27s. 6d.

These volumes deal with modern furnace engineering in a thorough way, covering a wide range, and treating on furnace plants of very varying type. Volume I, now in its second edition, treats of the principles and conditions belonging to most industrial heating operations, and of the design of many classes of furnaces, the subject-matter being divided into sections on the capacity, the economy and thermal efficiency, the strength and durability, and the movement of gases in such plants. Volume II, on the other hand, deals more with the operation of various types of furnaces than with their design. Descriptions are also given of plant used for the burning of different fuels, and there is information on the properties of different classes of fuels used for heating furnaces and on the equipment necessary for their preparation. Both volumes are copiously illustrated, no fewer than 575 line-drawings, diagrams and other reproductions and charts appearing.

Przepisy do Kontroli Fabrykacji w Cukrowniach i Rafinerjach. (Nakladem Centralnego Laboratorjum Cukrowniczego, Warsaw). 1926.

These are the methods of control for use in Polish sugar factories in carrying out their scheme of mutual chemical control. They have been compiled by Prof. K. Smolenski, and Messrs. A. Siwicki, and Br. Nowakowsji, and the result is a handbook, which leaves nothing lacking in respect of clearness and completeness.

Relations between Rotatory Power and Structure in the Sugar Group. Part I. By C. S. Hudson. Scientific Paper of the Bureau of Standards, No. 533. (Department of Commerce, Washington, D.C., U.S.A.). 1927.

In 1909 a beginning was made in correlating the structures of sugars with their rotatory powers by the author's application of Van't Hoff's hypothesis of optical superposition to the sugars and various of their derivatives, which method and its results have come into extensive use in the fields of organic and stereochemistry. In the present work the author's various articles have been arranged, either in full or with some condensation. The orderly presentation of the subject should assist research workers in the use of this new method of investigation in stereochemistry.

Malaria : Curse, Cause, and Cure. Compiled by Elisabeth, Countess of Carnarvon ; with a Foreword by Sir Ronald Ross, K.C.B., K.C.M.G., etc. (John Bale, Sons & Danielsson, Ltd., London). 1927. Price : 1s. (unbound).

Lady Carnarvon points out in her preface that, while medical men and States do their share in combating the malaria scourge, individual effort is essential, and that without the understanding and co-operation of the people no lasting result can be obtained. Her little book, issued at a price that can hardly do more than cover the cost of publication, describes in brief, clearly-expressed sections points such as the nature of the disease, its development, modern methods for the destruction of the mosquito larvae, anti-malaria organization, self-protection by householders, the use of quinine, and anti-malaria measures in different countries. Lady Carnarvon has for some time past interested herself in this branch of public health, and evidently knows much about it. Her book, which contains so much information in a small space, should assist greatly the purpose for which it is intended, viz., the dissemination to the general public of elementary knowledge of means and methods of destroying malaria.

Memorandum on Rivers Pollution. (Fishmongers' Company, Fishmongers' Hall, London) 1927.

This is a Memorandum submitted to the Prime Minister by a Joint Committee of the British Waterworks Association and the Salmon and Trout Association, and supported by other bodies. Its publication forms part of a movement to reconcile the conflicting interests concerned with our rivers, a movement which certainly is in no sense directed against industry.

Review of Current Technical Literature.[1]

Some Relations between H.I.C. and Defecation of Cane Juice. **H. S. Paine and R. T. Balch.**[2] *The Planter*, 1927, **73**, No. 7, 127-132, No. 8, 148-150.

Raw cane juice from the mills contains a quantity of finely divided *bagacillo*, soil and other suspended material which makes it very difficult to determine just what portion represents the true sap of the cane stalk. It is a mistake to consider a juice after filtration through infusorial earth as being strictly equivalent to true cane juice, although a study of juices so treated does throw some light upon clarification processes. Deerr[3] has shown that approximately 75 per cent. of the total quantity of non-sugars eliminated by heat and lime may be removed simply by filtering through asbestos. This eliminated material must then have consisted, for the most part, of *bagacillo* and other particles of greater than colloidal size. In filtration through asbestos, especially if continued for a sufficiently long time, ultra-filtration effects may occur, thereby removing some material that originally existed in a colloidal state, particularly that portion which has been designated in previous papers[4] as " water irreversible " colloids. Heating cane juice at its original acidity after filtration as above indicated produces but a trace of a precipitate, indicating that heat alone at this pH value is of little or no consequence in the removal of colloids or other non-sugar substances. An examination of the data on muds obtained from juices limed to neutrality to phenophthalein reveals the fact that approximately 20 per cent. of the total precipitate is ash, which according to Bond,[5] consists principally of CaO and P_2O_5 with appreciable quantities of magnesium, aluminium and iron. The alkaline reaction causes the precipitation of calcium, aluminium, iron and magnesium as phosphates with perhaps some magnesium hydroxide. Iron and aluminium in moderate amounts are difficult to remove as hydroxides from solutions containing sugars, this being due to the so-called protective action of the latter. They may, however, be adsorbed to a certain extent, in addition to organic colloids, by phosphate precipitates. Within the range of moderate alkalinity used for cane juice defecation, it seems certain that few, if any, of the reactions are quantitative, and the best that can be hoped for by present processes is a partial removal of these non-sugars from the juice. By calculation, organic material other than that originally present in visible suspension constitutes only about 5 per cent. of the total quantity of non-sugars eliminated from the juice by liming. This quantity is comparatively small. Nevertheless we are interested in knowing in what manner this material is removed from the juice. The possibilities seem to have narrowed down to practically two, namely, the formation of salts of organic acids which are insoluble in alkaline solution and the adsorption of colloids (which may be both organic and inorganic) by the flocculent phosphate precipitate. It is probable that both of these reactions occur during the defecation process as the type of precipitate produced in this case usually has a high adsorptive capacity for colloids. The information available on the removal of colloids from cane juice, if any, which might occur either by the neutralization of their electric charges, due to the introduction of materials bearing opposite charges, or by the adjustment of the pH to their iso-electric point, is extremely meagre and must be obtained before an accurate conclusion can be drawn in regard to the possible maximum extent of colloid elimination by liming and before means for increasing the efficiency of defecation from this standpoint can be prescribed. In recapitulation, clarification consists principally in the removal from cane juice of the following : (1) *bagacillo* and other suspended material (which may be eliminated by ordinary filtration) ; (2) certain inorganic substances which are insoluble to the greatest extent in alkaline solution and consist principally of calcium, aluminium, iron and magnesium precipitated by phosphates, hydroxides and salts of organic acids ; (3) colloidal substances eliminated most probably by adsorption by the flocculent phosphate precipitates. The inference in regard to adsorption of colloidal material is further substantiated by an experiment here reported, in which a small amount

[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S J.*

[2] Of the Carbohydrate Laboratory, Bureau of Chemistry, Department of Agriculture, Washington, D.C., U.S.A.

[3] Deerr, "Cane Sugar," (Norman Rodger, London).

[4] Paine, Badollet and Keane, *I.S J.*, 1925, 147 ; Badollet and Paine, *I.S J.*, 1926, 23, 97, 137, 497.

[5] Bond, *I.S.J.*, 1925, 311.

of phosphoric acid was added to a juice sample and an analysis of the resulting mud was made. The loss on ignition of the mud showed that an increased quantity of organic material, presumably of a colloidal nature, was removed by the calcium phosphate precipitate. In the type of cane juices on which the above experiments were made it was necessary, for maximum clarification, to lime to a *pH* value between 8·0 and 9·0 for cold juice (less for heated juice). In the case of the samples prepared by directly mixing portions of juice from the different mills, it was possible to obtain, at times, a fairly brilliant defecated juice at a *pH* between 7·8 and 8·0. The effect on clarification of variation in temperature was not investigated, as it was believed that such variation did not influence the quantity of material removed from the juice as much, as it did the character of the precipitate, provided the temperature only varied within the customary limits (200-215°F.) The data obtained showed that the *pH* of limed juices decreased at a fairly definite rate when the juices were heated and indicate that the change in *pH* depends upon the initial *pH* value, the temperature, the period of heating, and also upon the character of the juice. In practice it would be undesirable to allow this decrease in *pH* to proceed to such an extent as to cause sucrose inversion losses, which become detectable at a *pH* value in the region of absolute neutrality, *pH* 7·0. When dilute juice is kept near the boiling temperature this point is reached in three to six hours ; hence in order to prevent appreciable inversion loss, the defecation and evaporation processes should be so controlled as to time and temperature that the juice reaches the syrup stage with a *pH* value not less than 6·8 to 7·0. Provided sufficient filtration capacity is available, the indicated procedure for maximum clarification and for prevention of inversion losses, under the conditions prevailing in this investigation, is to lime the juice to a *pH* value between 8·0 and 9·0 measured either before or after heating. The drop of 0·2 to 0·3 in *pH* value upon first heating limed juice apparently does not affect the clarification, but of course should be considered if the reaction of the syrup is found to be on the border line from the standpoint of danger of inversion. However, it must be remembered that, in addition to those just mentioned, there are other factors to be considered in cane juice defecation. Among these may be mentioned the percentage of calcium salts in the clarified juice (in relation to scaling of heating surfaces) and the colour of the juice, particularly if there is reason to believe that any increase in colour which may occur at the higher *pH* values adversely affects the quality of the raw sugar produced. The *pH* range required for the maximum defecation effect may also vary with different juices. It is highly desirable that these various factors be definitely evaluated so that an intelligent choice of *pH* range for defecation can be made which will be most suitable for the particular equipment of each factory and the character of juice handled. An investigation including these various phases is now being made by the authors.

PHILIPPINE MILLING NOTES (GROOVING, ROLLER SETTINGS, ROLLER ALIGNMENT). **Theo. Nickelsen.** *Sugar News.* 1926, 7, No. 7, 463-464.

The size of the grooving of the rollers should be made to meet local conditions, e.g., proportional size of mill to the size of the crop, character of cane, boiling house capacity, and last but not least, boiler capacity and design. It is now generally accepted that heavy grooving of the first mills is essential to quantity and quality of milling, so that 1¼ in. to 1¾ in. or even 2¼ in. pitch grooves of the first mills of a train will be rather the rule than the exception in future installations. The grooving of the third, fourth and fifth mills should be made to accommodate the tonnage, though a ⅝ in. intermeshing pitch groove of lower and upper rolls generally gives low moisture bagasse with consequent good milling results. The setting of the returner-bar is not the serious problem that it was in bygone years, and a range of from 1½ in. to 2 in. centre distance of bar to top roll will generally take care of any quantity and quality milling which may be necessary. The distance from the point of the toe of the returner-bar to the top roller should never be less than 90 per cent. of the central distance, and a little more will generally relieve the tension on bar, when heavy milling practices are the rule. Badila cane with its spongy-like texture of fibre, generally gives a little trouble to close set mills, and to keep extraction and quantity

milling production up to standard, a free floating top roll is very necessary. Often, varieties such as Yellow Caledonia, with its large and tough fibre, will necessitate different mill settings, but all of these can be taken care of by either reducing the hydraulic pressure, or allowing the rolls to lift freely without weights for a certain distance, by the insertion of liners under the jacks.

Juice grooves of the Messchaert type are now in general use, and are indispensable to close setting rollers with consequent quantity and quality milling. The deepening of the juice grooves, wherever permissible, lowers the moisture content of the final bagasse, regardless of a maceration variation within 10 to 15 per cent. Too much emphasis cannot be placed on the importance of free floating top rolls, a close setting feed roll, and a medium low bar without any bumps on its working face, as any obstacles to the travelling bagasse blanket are detrimental to good work and even though the day's or the week's work necessitate a wide tonnage variation, there will be no need to alter the lower roller settings, as the increase in the mill capacities by an increased roller opening will only be necessary to relieve the weights on the top roller, and not change the feed roll or discharge roller settings. The opening up of a feed roll very often alters the returned-bar setting, and may cause a change detrimental to good milling; whilst increasing the lift of the top roll gives a proportionate thickness increase to the blanket at all points, and is not so apt to cause slippage at the point of discharge, and the extraction then is not lowered even though the tonnage quantity is materially increased. Keeping the lower rollers in alignment with the top roll is a very important factor to smooth running, higher power transmission and efficient milling. The effects of "out of alignment" rollers are many and varied, but the principal danger lies in the liability of the shells to move on the shaft when working under big loads and heavy pressures. The power consumed for efficient work rises materially in a haphazard set mill, and the engineer's attention is specifically called to this "alignment of roller policy" which should have strict attention from the mill operators.

Some Formulae for Use in Chemical Control. **S. S. Peck.** *Paper read before the Association of Hawaiian Sugar Technologists*, 1926 *Meeting.*

Mr. Peck proposed some important new formulae for use in chemical control, suggesting that a committee be appointed to investigate their use. In the first place he is dissatisfied with the figure "Quality Ratio," holding that it is frequently misinterpreted and is not comparable between different plants. Instead he proposes a new figure "Tons Cane per Ton Sugar." "A new standard is suggested in which there shall be allowed no losses in extraction, press-cake, or undetermined, based on the polarization of the cane, the purity of the first expressed juice, a molasses of thirty-three and one-third purity, and the sugar as actually made. Then no factory can achieve this standard; it will not rest on an assumed Java Ratio; and the figure will be referred to the actual quality of sugar produced. The figure for purity of molasses lends itself to easy formula development, becoming :—

$$\text{Tons Cane per Ton Sugar} = \frac{P\ (3S - D)}{C\ (3P - 100)}$$

where P is purity of first expressed juice, D is solids per cent. sugar, S is polarization of sugar, and C is polarization of cane.

A better figure for judging the use of maceration water would be "Maceration per cent. Cane" instead of "Dilution per cent. Normal Juice." The question of admixture of maceration water with the residual juice in bagasse has been often discussed. In 1909 Dr. Norris printed the formula :—

$$\frac{\text{Brix Expressed Juice} \times 100}{\text{Brix Residual Juice}}$$

as indicating the efficiency of admixture of maceration water, but described the limitations of its application. The definition of what constitutes admixture is still uncertain. If only water is applied as maceration, and if the fibre in the bagasse leaving the mill is the same as that entering, the formula above given is correct. It is not correct if the fibre contents vary or dilute juice constitutes the maceration.

In the case of water, if we consider the amount of water as indicated by the formula mixes perfectly with the residual juice in the entering bagasse, and that the excess goes into the juice pan without extracting any sugar, the resulting juice consisting of expressed juice and excess water has the Brix relating to the Brix of the residual juice in the bagasse under consideration, the rest going to the juice pan un-enriched by sugar, then the following formula applies :—

$$\text{Coefficient of Admixture} = \frac{(J - M) - \dfrac{B\,(R - J)}{W + D}}{R - M}$$

where R = Brix of Residual Juice ; J = Brix of Maceration ; W = Water added to Last Mill per cent. Cane ; M = Brix of Maceration ; B = Difference between Bagasse per cent. Cane entering Mill and that leaving, before Maceration is applied ; D = Difference between Bagasse per cent. Cane leaving Mill and Final Bagasse per cent. Cane. " This formula is admittedly not easy of application, the greatest difficulty being the determination of the Bagasse per cent. Cane from intermediate mills. This is no harder to accomplish than the obtaining of samples in a dry crushing test. When determined, there is then the possibility of determining the effectivemess of the application of macerating liquors."

CHEMICAL TREATMENT OF EVAPORATOR SCALE. **W. Scott.** *Tropical Agriculture,* 1926, 245-246. At the Usine Ste. Madeleine, Trinidad, the scale from the 4th calandria contained 35-40 per cent. of calcium sulphate, as well as silicate and phosphate, and no satisfactory results could be obtained with soda having less than 12-14 per cent. concentration, boiling being continued for three hours, at the end of which time the treatment was followed up with ½ per cent. hydrochloric acid for one hour. The cost of this process is somewhat higher than the combined acid and hand cleaning method previously used, but the difference in cost is described as trifling compared with the results obtained.—INFLUENCE OF MANGANESE IN MANURING THE CANE. **E. Haddon.** *La Revue agricole,* 1926, No. 28, 161-162. In Mauritius molasses containing about 0·00075 per cent. of manganese was found to act as stimulant to the nitrogen-fixing bacteria, the assimilation being 5 mgrms. of nitrogen as compared with 3, for each grm. of sugar added. Manganese sulphate was tried in admixture with nitrate of soda and sulphate of ammonia, when the yield of canes was in the ratio of 122, as compared with 100 without this addition of metallic salt. Soil of a field under cane cultivation was found to have the following amounts for manganese for each depth of 6 in. : 0·321, 0·218, 0·125, 0·033 and 0·011, while at a depth of 5 ft. none could be found.—BEET PECTIN. **E. K. Wilson.** *Jl. Amer. Chem. Soc.,* 1926, **48**, 2945-2946. While evidently an essential constituent of beet pectin, the acetyl group is not an essential constituent of pectins in general. Root pectins, such as beet pectin, may be related to or derived from lignin, ligno-cellulose or cell materials containing acetyl groups in their molecules. Fruit pectins, so far as examined, differ from sugar-beet pectin in being practically devoid of acetyl groups.—UTILIZATION OF MOLASSES DISTILLERY SLOPS (VINASSE) AS BINDER FOR THE MANUFACTURE OF BRIQUETTES. **Wm. C. Moore and Henry A. Myers.**[1] *Industrial and Chemical Engineering,* 1927, **19**, No. 1, 147-149. Briquettes (2½ oz. size) were made in a plunger press under 7000 lbs. with 93 per cent. of 8-mesh anthracite dust and 7 per cent, of molasses distillery residue (evaporated to a density of 1·3 or 33 Bé.). and baked at 600°F. (316°C.) for not less than 10 min. Other formulae were tried. A combination of asphalt, sodium carbonate, calcium chloride and sulphur with the evaporated slops makes an excellent binder.—DECOMPOSITION OF CELLULOSE IN THE SOIL. **S. Winogradsky.** *Comptes rendus,* 1926, **183**, 691-694. *Spirochoeta cytophaga* in the first stage of its action on pure cellulose is transformed into a translucent colloidal substance believed to be an " oxycellulose." —BLENDING SYRUPS AND MOLASSES IN LOUISIANA. **Wm. L. O. Whaley,** *Facts about Sugar,* 1926, **21**, No. 43, 1018-1019 ; 1927, **22**, No. 6, 135-137. Discusses the effect of temperature during the subsiding, one of 130-140°F. (54·5-60°C.) for 24 hours or

[1] Industrial Alcohol Co, of Baltimore, Md., U.S.A.

longer being advised; also remarks on the causes and conditions of sediments; and blending with glucose syrups. Many difficult problems are involved in the production of table syrups.—DETERMINATION OF SUGAR IN THE BEET. **V. Stanek and J. Vondrak.** *Zeitsch. Zuckerind. Czecho-Slov.*, 1926, **51**, 101-108, 113-121. Hot digestion methods in general give results which are too high. Thus, when using 104 grms. of pulp and 30 c.c. of dilute lead subacetate, figures result which are 0·22 per cent. higher than the truth; whilst when the proportions are 52 grms. and 354 c.c. (or in a 401·2 c.c. flask) the error is about half that just stated. This is caused by the fact that the volume of the pulp is actually higher than is at present assumed (0·6 c.c. for 26 grms. of pulp), the authors having found a correction of 1·04 to 2·38 c.c. to be applicable (an average of 1·56 c.c.). In consequence, the volume of the juice instead of being 23 c.c. for the normal weight should be from 21 to 22·4 c.c., an average of 21·8 c.c.—VOLUME OF THE MARK IN THE HOT WATER (DIGESTION) METHOD OF DETERMINING SUGAR IN THE BEET. **O. Spengler and C. Brendel.** *Zeitsch. Ver. deut. Zuckerind.*, 1926, 880-886. Similar determinations made by these authors of the "mark hydrate" (or mark plus its colloid water) of beet pulp from the 1926-27 campaign, show that the figure should be 9·3 per cent., or 2·42 for 26 grms., which with a sp. gr. of 1·13 is equal to 2·1 c.c. Therefore the flask should be calibrated at 202·1 c.c. This means that if a result of 16 per cent. sucrose in the beet were found by the present method, it would be 15·88 per cent. using the new correction, the undetermined losses being diminished accordingly.—ORIGIN AND MIGRATION OF THE DIFFERENT SUGARS IN THE BEET. **Oscar Spengler and Rodolf Weidenhage.** *Zeitsch. Ver. deut. Zuckerind.*, 1926, 767-778. Periodical determinations made during the period of development (in 1926) showed that the stalks throughout contain a considerable amount of reducing sugars, dextrose probably predominating, and an inconsiderable amount of sucrose. In the top the sucrose is in excess, though its content there in reducing sugars is always distinctly higher than in the body of the root, the sugar in which consists almost wholly of sucrose. In the leaves invertase and amylase are active through the whole period of growth, and it appears likely that the migration of sugars from leaf to root takes place in the form of monosaccharides. In general the work of RUHLAND[1] and of COLIN[2] is confirmed.—APPLICATION OF SPECTROPHOTOMETRIC MEASUREMENTS IN THE (BEET) SUGAR INDUSTRY. **Harald Lunden.** *Ibid.*, 1926, 780-800. Spectrometric measurements are of much value in distinguishing between the different colouring substances encountered during manufacture or refining, those already present, those developed, and those eliminated. It is possible to estimate them spectrometrically, and so judge of the effect of clarification, of affining, of treatment with char or carbon, etc., as well as indicate those which are more refractory than others. Certain shades correspond to certain tastes. Juice syrup or sugar containing amethyst colouring, for example, has a very unpleasant taste (as raw beet juice), and purification methods which act on this colour also remove the repulsive flavour. A sugar of amethyst shade develops a much worse flavour on heating, any sweetness being thus almost eliminated, whereas caramel is accompanied by a more harmless taste. On warming good sugars, caramel colours develop having a strong light absorption in blue and violet, but inferior samples form amethyst shades principally, which are best observed in yellow light. DETERMINATION OF SUGAR IN CARBONATION SCUMS. **Ed. Kunz.** *Zeitsch. Ver. deut. Zuckerind.*, 1926, 834-878. This is a matter which has been the subject of controversy about two years ago.[3] Continuing his part in the discussion, the author has constructed correction tables taking into account the effect of calcium acetate on the results obtained by the direct and double polarization methods. Using this table he has repeated a number of determinations by Vondrak's method (solution in acetic acid) and by the Institute's procedure (preliminarily triturating with ammonium nitrate) finding the latter still are lower (4·47 against 4·89 per cent.). His theory of the presence of "carbonate sugar" is still maintained, it now being observed that this dextro-rotatory substance is present only in saturated and not in unsaturated scums.

J.P.O.

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[1] *Zeitsch. Ver. deut. Zuckerind.* **62**, 1.
[2] *Revue générale de Botanique*, 1916, **28**, 289, 322, 368; 1917, **29**, 21, 57, 89, 113.
[3] *I.S.J.*, 1925, 335.

Review of Recent Patents.[1]

UNITED KINGDOM.

Mill Macerating Device ("Macerotor"). **Francis Maxwell**, of 11, Park Ave., Wallington, Surrey. 263,893. July 9th, 1925.

In extracting juice from cane, it is subjected to cyclically repeated groups of operations each comprising crushing, agitating or shredding, or both, and macerating steps transposably associated in near or distant relationship with each other. As shown in Fig. 2, the agitator consists of a rotary hollow cylinder *c* provided on its surface with disintegrating elements such as teeth, spikes, or bristles *d* and mounted on a shaft *e* behind the upper mill roller *a* and above the delivery roller *b*. The cylinder *c* is of small diameter compared with the rollers *a*, *b*; and the shaft *e* may be driven by a motor supported on the mill framing, or from the mill gearing. A macerating-agent (water or juice) is delivered by a pipe *l* into the top of a structure *j* enclosing the rotor *c* and the portions of the rollers *a*, *b* immediately adjacent thereto. The structure *j* may be shaped as a casing or hood secured to the mill framing and associated with the usual conveyer *k*. The pipe *l* is connected to the supply pipe *m* and is provided along its whole length and at the part of its face nearest the rotor *c* with a slot *n* or with a number of apertures. The crushed cane issuing

FIG.2.

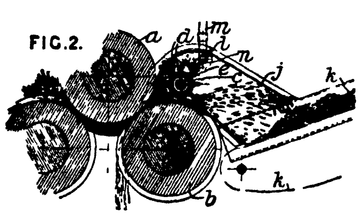


FIG 5.

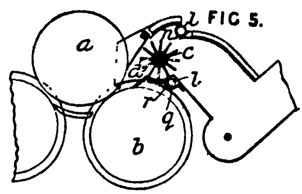


FIG.4.

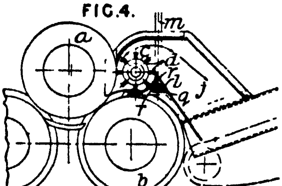
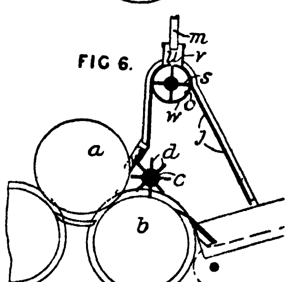


FIG 6.



from between the rollers *a*, *b* is broken up, scattered, or agitated by the spikes *d* and simultaneously the fragments are impregnated with the jetted macerating-agent which itself is also broken up and scattered by the rotor *c*. The pipe *l* may be situated within a compartment in the structure *j* and formed with one or more outlets immediately adjacent the space between the top roller *a* and the rotor *c*, so that the crushed cane is subjected to the agent before, or almost before, it comes under the action of the rotor *c*. In another arrangement, Fig. 4, the pipe *l* is arranged within a chamber *q* at the lower edge of the structure *j* in the region of the lower part of the rotor *c* remote from the roller *a*, and the agent is directed through apertures upon the underside of the crushed mass immediately it becomes subject to agitation. Fig. 5 shows an arrangement in which the agent is introduced above and below the rotor *c*. In Fig. 6 a rotor *s* is provided in connexion with the supply pipe *m* to impart an initial agitation to the agent prior to its delivery to the rotor *c*. The rotor *s* is housed in a compartment *o* of the structure *j*, the top being slotted at *n* to receive the agent from a pocket or well *v* into which the pipe *m* delivers, and the bottom being slotted at *w* for the discharge of the agent into the structure *j*. The

[1] Copies of specifications of patents with their drawings can be obtained on application to the following—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price 1s. each). Abstracts of United Kingdom patents marked in our Review with a star (*) are reproduced from the *Illustrated Official Journal (Patents)*, with the permission of the Controller of H.M. Stationery Office, London. Sometimes only the drawing or drawings are so reproduced. *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille, du Temple, Paris. *Germany:* Patentamt, Berlin, Germany.

rotor *c* and the macerating-pipe *l* may be situated at a distance from the rollers and from each other. Instead of a rotary agitator, a reciprocating or other kind of agitator may be used; or it may consist of means for supplying compressed air or other fluid or liquid, or a solid medium under pressure and directing it upon the mass of crushed cane (Specification 198,120 is referred to[1]).

COLOUR ESTIMATING APPARATUS. **Tintometer, Ltd., and F. E. Lovibond,** of The Friary, Salisbury. 263,924. October 3rd, 1925. For estimating the colour of a transparent or translucent substance with the aid of an apparatus, a reflector of predetermined colour and surface character is placed in front of the apparatus at a predetermined angle to the line of vision and is illuminated by an electric lamp of known illuminating power and colour-value so placed that the illuminating rays are not reflected directly into the eye of the observer.—BEET HARVESTERS. **J. & F. Howard, Ltd., and A. B. S. Steinmetz,** of Britannia Iron Works, Bedford. 263,963. October 14th, 1925. Beet and other root crops are lifted by a member *G* having a share *H*, the member *G* and the share being secured to a casting *I* at the bottom of a

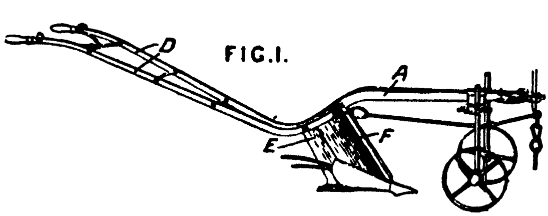
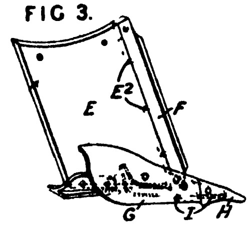


FIG 3.



steel plate *E* attached to the machine beam *A*. A renewing knife *F* is attached to the front of the plate *E*, being held in position by dowel pins E^2 or similar devices. The knife *F* is bolted at its upper end to the beam *A* and at its lower end to the casting *I*. The beam adjacent to the upper parts of the plate *E* and knife *F* is of T-section and its rearward extension forms one of the handles *D*, the other handle being secured to the beam by the bolts securing the plate *E*.

UNITED STATES.

CANE CARS. **Louis D. Gregg** (Assignor to the **Gregg Company, Ltd.,** of New York, U.S.A.). (*A*) 1,610,771. December 14th, 1926. (*B*) 1,610,772. December 14th, 1926.

(*A*) In order to carry the amount of cane required for their economical use, the older cars, with the three-foot (more or less) ends and sides ordinarily provided have been loaded high above the top of the superstructure, which could only be done by expensive hand labour. When the loading is done by mechanical derricks or other labour-saving devices, the ends and sides of the cars must be made about twice the usual height, or say six feet. This in itself renders unavailable the discharge door hinged on its lower side, since the height (or width) of the door does not permit it to swing down perpendicularly or far enough to be out of the way of the falling cane. Moreover, the increased pressure of the load, the cane instead of being hand-laid being in a more or less jumbled condition when dropped into the cars by the mechanical loaders, is too great for the side stakes supported only at their lower ends in stake-pockets, and hence it has been the practice to further support these taller stakes, at or near their upper ends, by a rigidly mounted horizontal rail. But, while cars equipped with stakes thus supported, and cars equipped with discharge doors pivoted at the top, can be unloaded by lifting the cane out from the top or by tipping the cars about thirty degrees to the side, the fixed rail for bracing the stakes or to which the swinging door is hinged renders impossible the use of either of the two forms of convenient mechanical rakes which have been developed for the purpose of raking the cane from the cars. With a view to remedying this defect, the inventor

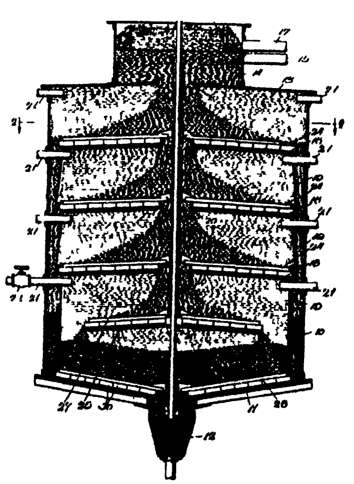
[1] See *I.S.J.*, 1923, 499.

has here provided a discharge side or end closure having as its essential feature a separable or two-piece horizontal rail, the two sections of which are respectively hinged at their outer ends to the two walls of the car, to swing outwardly thereon, and when moved to closed position are releasably joined at their inner ends to form a rail capable of sustaining the outward thrust of the load. A single rail mounted near the top of the walls is ordinarily used to brace the upper ends of the usual stakes or frames, or of stiff steel plates, which, if desired, may be attached to its sections and which at their lower ends are secured to the side of the under-frame in releasing stake-pockets or by a locking bar or other equivalent means. In some cases, however, the vertical members of the closure may be omitted and, in place thereof, an additional rail or rails may be mounted on the walls intermediate the top rail and the underframe. In either case, the closure when released and opened up leaves the entire side of the car clear above the underframe.

(*B*) This second specification provides a practical closure which, while retaining the stakes and its fixed top rail support, will permit of the use of unloading rakes; and to this end the invention consists, first, in extending the corner wall stakes on the discharge side or end of the car some 2½ ft. or so above the rest of the superstructure so that the rail fixed thereon will be at such height above the top of the load as not to interfere with the introduction of the rake mechanism, and, second, in so supporting the stakes on the rail that on the release of their lower ends they may either be removed or moved or swung aside to clear the side of the car.

Separation of Solids from Liquids. **Walton C. Graham, Horace S. Rumsey, and Ashur U. Wetherbee** (assignors to **Gilchrist & Company**). 1,602,014. October 5th, 1926.

In typical prior apparatus, the movement of the deposited material and of the clear liquid is in opposite directions, resulting in stirring up the liquid to some extent and causing some of the finer particles, at least, to be restored into suspension. An object of the present invention is to provide a parallel flow of deposited matter and of the clear liquid, whereby remixing of said solids and liquid is reduced to a minimum. An additional object is to provide operation through multiple stages of settling and drawing off the clear liquid which will increase the clarity of the final liquid, each stage maintaining equal efficacy, whereas with prior apparatus such successive operations decrease the effectiveness of the separation. The equipment comprises a suitable tank having an outer wall 10 which is preferably of cylindrical form having a bottom 11 which may be inclined to form a conical discharge with an outlet 12. The tank is closed by a top wall 13 having an auxiliary receptacle 14 (or a separate tank) constituting a reservoir for the fluid containing gas, air, or other substances, such as solid particles in a finely divided state, which are to be separated. A suitable liquor head is maintained in this tank by means of a supply pipe 15 communicating with the reservoir 14. An overflow member 16 is provided, whereby the scum may overflow the top thereof and be drawn off through the discharge pipe 17. The tank is divided preferably into a plurality of vertically superimposed chambers by one or more transverse partitions 18 which are preferably in the form of substantially horizontal discs separated from the outer wall 10, so as to leave a clearance space down which the accumulated solid matter flows. Although the drawing shows equipment having a plurality of settling chambers and a common lower chamber for the accumulated sediment, a single settling chamber is contemplated. At the peripheries of the circular shelves or



partitions 18 is a depending apron or flange 19 which is preferably slightly flared. With this arrangement each of the superimposed chambers is closed or shut off from the main body of the liquid except at the central inlet opening 20 and at the circumferential discharge clearance space near the bottom of the flanges 19. Suitable outlet pipes 21 are provided which communicate with the upper portion of each of the superimposed chambers and pass through the clearance space and the outer wall of the tank. Said pipes are provided with suitable valves 22, or other means of regulation. A rotatable shaft 23 passes through the tank and through the several openings 20 in the horizontal partitions, and has mounted on it a series of sweeps 24. When the shaft is rotated by suitable means (not shown) the rotation of the sweeps advances the sediment in each chamber towards the periphery thereof, causing it to fall downwardly through the annular clearance space between the outer wall 10 and the flanges 19. The lower chamber may be divided into an upper and a lower compartment by a transverse partition 25 having a small central opening 26 large enough for the shaft only, but not large enough for any appreciable flow of liquid. Another sweep 27, preferably somewhat smaller than those previously described, is mounted on the shaft 23 above said partition. An additional sweep 28 is mounted on said shaft at the bottom of the tank. As shown in Fig. 2, the sweeps are provided with means for advancing the sediment towards the discharge openings in each case. Such means may have the form shown in Fig. 2, consisting of blades of thin material 29 mounted at an angle with reference to the radial supporting arms, whereby rotation of the sweeps in the direction of the arrow will result in advancing the sediment to the periphery of the several transverse partitions. The blades 30 on the lowermost sweep at the bottom of the tank are arranged in the reverse direction in order to aid the sediment in discharging into the central outlet 12. In the description of the operation which follows, the term " fluid " is applied to the material being treated and varies in different parts. The liquid is what is drawn off as a result of the operation, or is clarified. The sediment is that which settles to the bottom of the apparatus and the scum is the floating foreign material, including gas (air) which may be a part of the scum, or the gas may escape separately from the scum. A suitable head of fluid is maintained in the tank and the sediment slowly settles to the bottom in each chamber, whereupon the slowly rotating sweeps push the deposited material towards the peripheries of the chambers causing said material to flow downwardly to the bottom compartment and to the outlet 12. The gases and floating material pass upwardly and are discharged through the auxiliary receptacle 14. The clearer liquid in each chamber will be found near the upper and outer peripheries thereof, as indicated in the drawing, and passes out through the various discharge pipes 21, which may be extended, if desired, to provide a plurality of radial outlets in each chamber. The downwardly extending flanges 19 provide an annular discharge chamber separate and distinct from the settling chambers, and thus prevent mingling of the sediment with the clear liquid as the sediment is flowing downwardly from the several compartments. It will be seen that the original fluid, which is turbid, is introduced at the centre of the compartment and flows slowly and at a continually decreasing rate, more or less radially outward, as the solids are settling to the bottom of the compartment, the gases and floating material rising to the highest point of the chamber, which, in this case, is the central opening. However, as the solids are deposited they are continually being removed mechanically in the same direction that the liquid is flowing : that is outwardly, and the gases and floating material are continuously passing out at the top. For this reason, there is less tendency to agitate the deposited material and cloud the liquid than in the prior practice in which there is a counter-flow of deposited material with reference to the clear liquid. Since the particles, which are the last to settle and therefore the easiest to be restored to suspension, are deposited at the points farthest removed from the inlet, at which point the velocity of flow of the clearer liquid is a minimum, they are the first to be discharged over the edge into a special receiving compartment at the bottom which is common to all of the separating chambers. In this manner fines once separated are not re-suspended to any appreciable extent while moving to the bottom of the receiving compartment.

Manufacture of a Nitrogenous Fertilizer.[1] **Eric H. Richards and Henry B. Hutchinson** (assignors to **Adco, Ltd.**, of Harpenden, Herts.). 1,619,679. March 1st, 1927. A process of manufacture of an organic nitrogenous fertilizer comprises bringing together a fermentable carbonaceous substance and a substantially water-insoluble hydrolysable compound of nitrogen, and maintaining these materials in contact in a highly hydrated state under aerobic conditions for a period of time sufficient to permit the ammonia assimilator organisms in the said carbonaceous substance to ferment the same and transform the initially applied nitrogen into new, water-insoluble, organic nitrogenous compounds in substantial quantity within the fermented mass.—Beet Harvester. **Ervin J. Hammer and Orrin H. Hammer**, of Miller City, Ohio, U.S.A. 1,620,019. March 8th, 1927. Claim is made for a beet harvester comprising a pair of finger wheels, movably mounted means supporting the finger wheels in confronting positions, means to continuously rotate them in the same direction upon said supporting means to take hold of a beet and carry it to a point of discharge, and resilient means exerting pressure upon said supporting means urging the wheels toward each other so that various sizes of beets are gripped equally well.—Clarifying and Purifying Waste Waters. **Andreas J. Ravnestad**, of Fredriksstad, Norway. 1,619,036. March 1st, 1927. A process is described for the purpose of clarifying and purifying waters containing suspended organic, mineral or colloidal substances comprising the addition of an organic colloid and of a flocculating agent for coagulating said colloid, and of a settling accelerator.—Treating Liquids with Decolorizing, Purifying, and Filtering Agents. **Johan N. A. Sauer**, of Amsterdam, Holland, 1,619,042. March 1st, 1927. An apparatus of the class described comprises a mixing vessel, a filter arranged above said vessel and communicating therewith, a collector located between the filter and the mixing vessel, a mixer in the said collector, a pump having a connexion to said collector, another connexion to the upper portion of the filter, and a third connexion to the mixing vessel.[2]—Revivifying Carbon. **Arthur A. Backhaus**, (assignor to the **U.S. Industrial Alcohol Co.**, of Baltimore, U.S.A.). (*A*) 1,619,326. (*B*) 1,619,327. March 1st, 1927. (*A*) Claim is made for the process which comprises revivifying and activated carbon used in purifying ethylene by applying live steam accompanied by indirect heat and then a hot dry gas thereto, in such a manner as to remove impurities therefrom. (*B*) And for that for revivifying an absorbent material used in a purification process by applying live steam accompanied by indirect heat and then a hot dry gas thereto, in such a manner as to remove impurities therefrom. Hydrometer. **John H. Peper** (Assignor to **Indiana Pipe Line Co.**, of Huntington, Ind., U.S.A.). 1,607,912. November 23rd, 1926. A hydrometer is described in which the scale is adapted to be read at a definite distance above the surface of the liquid in which it is immersed, the scale of the instrument being preferably read at a horizontal indicator rigidly held at a corresponding distance above the surface of the liquid. The indicator is provided with a knife-edge against which an accurate reading of the scale on the hydrometer is adapted to be taken, at the same time permitting the hydrometer to move up and down with practically no friction.—Furrowing Device for Cane Planting Machines. **William Kassebeer**, of Lihue, T.H. 1,606,799. November 16th, 1926. This specification relates to an attachment to cane planting machines, by means of which a relatively deep V-shaped furrow may be formed, this furrow being for the reception of cane seed at regularly spaced intervals. Actually the claim is for a furrow opener comprising a digging nose, means rearward of the nose for forming a furrow having diverging walls, means for making the walls of said furrow compact, and means for forming a row of soil in the base of the furrow simultaneously with the forming of the furrow.

A summary of the returns of 77 Cuban mills gave a yield of 96° sugar of 11·68 with 7·15 galls. (U.S.) per bag; the figures for the previous crop being 11·53 and 8·19. Cane ground in the two seasons was 41,923,540 and 45,505,811 tons, and the average daily grinding, 308,261 and 291,704 tons.

[1] See also U.K. Patent, 1,471,979, *I.S.J.*, 1924, 226; also U.K. Patent, 219,384, *I.S.J.*, 1924, 615.
[2] See also U.K. Patent, 172,962; *I.S.J.*, 1922, 273.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1927. Tons.		1926. Tons.
Total Receipts, January 1st to March 30th	689,762	..	908,053
Deliveries ,, ,, ...	689,581	..	831,558
Meltings by Refiners ,, ,, ...	667,598	..	782,000
Exports of Refined ,, ,, ...	13,000	..	23,000
Importers' Stocks, March 30th	115,543	..	85,151
Total Stocks, March 30th	218,743	..	207,987
	1926.		1925.
Total Consumption for twelve months	5,671,335	..	5,510,060

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR,
1925, 1926, AND 1927.

(Tons of 2,240 lbs.)	1925. Tons.		1926. Tons		1927. Tons.
Exports	940,585	..	817,666	..	549,401
Stocks	623,658	..	684,263	..	702,733
	1,564,243		1,501,929		1,252,134
Local Consumption	23,000	..	23,000	..	18,000
Receipts at Ports to February 28th	1,587,243		1,524,929		1,270,134

Havana, February 28th, 1927. J. GUMA.—L. MEJER

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR THREE MONTHS ENDING MARCH 31ST, 1925, 1926, AND 1927.

IMPORTS.

	1925. Tons.	1926. Tons.	1927. Tons.
Refined......	173,022 ..	159,320	125,468
Raw	257,930 ..	359,371	250,372
Molasses	27,526 ..	52,801 ..	24,331
	458,478	571,492	400,171

EXPORTS (Foreign).

	1925. Tons.		1926 Tons.		1927. Tons.
Refined...... ..	442	..	456	..	584
Raw...........	140	..	598	..	277
Molasses	139	..	1,025	..	104
	721		2,079		965

HOME CONSUMPTION.

	1925. Tons.		1926. Tons.		1927. Tons.
Refined	184,701	.	114,467	..	139,353
Refined (in Bond) in the United Kingdom	170,153	..	210,423	..	164,631
Raw	23,024	..	40,666	..	39,815
Total of Sugar	377,878		365,556		343,798
Molasses	1,431		1,700	.	1,497
Molasses, manufactured (in Bond) in United Kingdom .	15,268		16,490	..	21,057
	394,577		383,746		366,352

STOCKS IN BOND IN THE CUSTOMS WAREHOUSES OR ENTERED TO BE WAREHOUSED AT MARCH 31ST, 1927.

	1925. Tons.		1926. Tons.		1927. Tons.
Refined in Bond	37,500	..	67,100	..	68,550
Foreign Refined	22,550	..	157,850	..	86,200
,, Unrefined..	125,700	..	264,150	..	170,650
	185,750		489,100		325,400

United Kingdom Monthly Sugar Report.

Our last report was dated 8th March, 1927.

Since our last report sugar markets generally have had a serious setback. The accumulation of sugar at the Cuban ports, coupled with the bad trade demand and the Eastern disturbances have all had a decidedly weakening effect on the market.

The London Terminal market has not been so active as recently, and registrations have not been in such large volume. Speculative interests seem to be veering round more from the old crop to the new crop position. Unrest in the East and the fear that in the approaching Budget a change may be made in the sugar duties, which might include some sort of preference to the British refiners, has caused the market to become unsettled, and prices have shown a marked decline. March fluctuated from 18s. to 16s. 10½d. to 17s. 4½d. and was finally liquidated at this latter price. May moved from 18s. 5¼d. to 17s. 2¼d. to 17s. 9d. to 16s. 11¼d. to 17s. 6d. to 16s. 6d. to 16s. 7½d. August was traded in from 18s. 5¼d. to 17s. 4½d. to 17s. 10½d. to 17s. 2¼d. to 17s. 9d. to 16s. 9d. to 17s. The fall of new crop has not been so severe. October moved from 16s. 9d. to 16s. to 16s. 3d. to 15s. 7½d. to 15s. 10½d. December sold from 16s. 3¾d. to 15s. 3¾d. to 15s. 6¾d., whilst March on the new basis was traded in from 17s. 11¼d. to 17s. 1½d. to 17s. 4½d. The latest prices are, May 16s. 7½d., August 16s. 11¼d., October 15s. 9¾d., December 15s. 6d., March 17s 4½d.

The demand for actual sugar has been most disappointing and the trade has been exceedingly poor. This is probably accounted for by the approaching Budget, coupled with the trouble in the East, which brings with it the fear that White Javas in big quantities may find their way to the West instead of being consumed out East.

Ready Czecho Granulated has been scarce, but has sold from 18s. 1½d. down to 17s. 6d. Dutch Granulated has been more plentiful and sold down from 18s. 9d. to 17s. 6d., whilst 3d. per cwt. premium has been asked for May/August. American and Canadian Granulated c.i.f. sold from 19s. 7½d. to 18s. 6d. White Javas have been offered down from 18s. to 16s. 9d. c.i.f. for July shipment without much business being effected. Spot Granulated has fallen from 31s. 7½d. to 30s. 7½d. duty paid.

Home Grown has been difficult of sale and the price for Ely and Ipswich was marked down to 30s. 6d., at which level fair business was done. Other factories obtained 6d. to 1s. per cwt. better prices.

The British refiners on March 15th reduced their price for Cubes by 1s. per cwt. and Granulated by 6d. per cwt. Since that date no change has been made. Their latest prices are, No. 1 Cubes 36s. 3d., London Granulated 32s. 4½d.

The value of Raw sugar has fallen from 15s. 1½d. to 13s. 10½d. c.i.f. and a fair business has been done in between these prices, both to the British refiners and also to the Continent. The value of Cubans to-day is 14s. to 14s. 1½d.

In New York the demand has been disappointing and owing to the accumulation of sugar in Cuba weak markets have been experienced. Although Cuba has not pressed her sugar, Porto Ricos and Philippines have been selling freely. The market has declined from 3⅛ to 2⅞ c.i.f. The Futures market has fallen about 35 points.

With regard to the sowings in Europe, Dr. Mikusch has estimated an average increase of 8 per cent. whilst F. O. Licht states that the average increase excluding Russia will be 10 per cent. and including Russia, 12 per cent.

Stocks in Cuban ports have been rapidly increasing and stand to-day at 1,310,347 tons against 1,193,157 tons last year, whilst the receipts to date are 2,408,816 tons against 2,517,127. The production to March 31st is estimated at 3,562,000 tons against 3,496,000 tons in 1926.

21, Mincing Lane,
London, E.C. 3.
April 9th, 1927.

Arthur B. Hodge,
Sugar Merchants and Brokers.

THE

INTERNATIONAL SUGAR JOURNAL.

☞ All communications to be addressed to "The International Sugar Journal," 2, St. Dunstan's Hill, London, E.C. 3.

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

No. 341. MAY, 1927. VOL. XXIX.

Notes and Comments.

Sir Edward Davson on Empire Development.

Last February Sir EDWARD DAVSON, the well-known West Indian merchant and estate owner, was the guest of honour at a West Indian Club dinner in London, when suitable tribute was paid to him for his multifarious labours on behalf of the West Indies. Among his achievements we need only cite the founding of the Associated Chambers of Commerce of the West Indies. His gifts of statemanship have more recently been recognized by his appointment not long since as a member of the Empire Marketing Board, and also of the Grants Committee of that Board; while he has the intention, we gather, of standing for Parliament when an opportunity occurs.

In the course of acknowledging the toast in his honour, Sir EDWARD DAVSON discussed the outlook for our West Indian colonies, and enumerated a number of steps that had been taken by the Marketing Board to further the interests of various parts of our Empire. He emphasized that there were within the Empire enormous possibilities for development, only waiting to be served by the improved means of communication being perfected nowadays—steamship, wireless telegraphy, and aviation. As regards aviation he ventured the forecast that within two years we should be able to reach Australia from England in ten days.

As regards the work of the Empire Marketing Board, he mentioned that it had two objects in view: (1) to bring home to the people of this country the need to buy Empire goods, and (2) to endeavour to stimulate the production overseas of what was required in this country. Amongst the methods adopted to achieve the second result was the granting to suitable objects of donations of money to carry out research and investigation, while the first object would be aided by means of a publicity campaign. Amongst the grants already made were those to Fruit Research stations, both at home and abroad, to the Imperial College at Trinidad, to a research station at Tanganyika in East Africa (whither Mr. NOWELL had been sent as Director just after accepting the post of Director of the Department of Agriculture in British Guiana), to the Jamaica Producers' Association. But he pointed out that more applications for such grants might be made by the West Indies; whether grants were acceded to or not, they would not be given unless they were asked for.

In view of the fact that some 10 per cent. of the crops of the Empire are lost through insect pests, the Bureau of Entomology is receiving a grant to enable it to establish a station where would be bred parasites collected from all over the world, and any country suffering from an insect pest could then apply to the station for the requisite parasite.

Sir EDWARD DAVSON touched on the subject of Trinidad College, and remarked that he felt that the West Indies generally were not making as much use of it as they might. To compete with the big scientific stations established in other countries it was necessary for the West Indies to concentrate their energies and their funds on a *co-operative* support of the Trinidad establishment, much as had already been done in regard to Chambers of Commerce. The islands might also give more definite attention to the proposal to finance a Trade Commissioner service for the West Indies in London, so as to save the time lost in communicating from London with each or any of these colonies.

Finally, he pointed out that the Empire Marketing Board was going to make great use of the Imperial Institute in London as a means of carrying out research in regard to various Colonial products. Their idea, in fact, was to create at the Institute a miniature but permanent "Wembley" exhibition of Empire production.

The Outlook in British Guiana.

In our March issue we referred to the fact that two Members of Parliament had returned from a trip to British Guiana, whither they had gone at the request of the Government to investigate the economic resources of the Colony. Their report has now been issued as a Blue Book, and while it is mainly taken up with the question of administration and development and various suggestions for improving the local finances, references to the sugar industry, which more immediately concern our readers, are not lacking.

The long-established importance of the sugar industry in the welfare of this colony is shown by figures given. As far back as 1836 when the population was but 98,000, some 59,000 tons of sugar were exported of the value of £1,847,786, the percentage of sugar to all exports being no less than 84. In 1925 the figures are appreciably different: the population by now has risen to 304,000, the sugar exported that year amounted to 97,000 tons, but was valued at only £1,551,745; and the percentage of sugar to all exports, while still the largest item, had fallen to 53. Out of 139,543 acres under cultivation about 57,000 are devoted to sugar, rice and coconuts being the next two largest items. The Commissioners visited several of the most important sugar plantations and factories, and were struck by their efficiency. They discussed the problem of the industry with the planters, and it was urged that a 20 years' stabilized preference is in every way desirable if the production is to be increased to half a million tons annually. But the Commissioners point out that excessive dependence on sugar has always been a fundamental weakness of British Guiana, and that the colony needs more diversity of production. Efforts have, it is true, been made in the past by some of the sugar planters to grow and cultivate alternative crops to sugar—coconuts and rubber for instance—but these have had to be abandoned, usually on urgent representations from principals at home to cut down expenses when adverse market conditions were ruling for sugar. It is not surprising, however, that these crops have failed to prove attractive, since coconuts require ten years to arrive at maturity and rubber trees five years. The Commissioners suggest another

alternative for the planters' consideration, viz., the cultivation of ground nuts, which might either be sown as a catch crop or as a rotation alternative to sugar cane. These nuts, which are of value for the oil they contain, would command a ready market in the United Kingdom similarly to the West African nuts at present imported by our Home oil millers, and they are quickly grown.

Touching on the question of Labour, the Report expresses the view that British Guiana is exceptionally suitable for Indian colonization, being in fact the natural Canada or Australia of British India. But the last tentative proposals of the Indian Government for encouraging emigration to South America would involve the Colony in an altogether excessive expenditure to settle the Indians on the land, this being about £76 per head; and the Commissioners think the Colony would be better advised to devote such resources as are available to the encouragement of immigration from the West Indies, where, especially in Barbados and Jamaica, there is a surplus black population which at present seeks an outlet in Cuba, Panama and other foreign countries. Something has already been done by the Government to recruit labour in Barbados, but more extended effort is apparently needed.

One or two incidental remarks the Report makes may be cited in conclusion. The system of export duties in force in British Guiana is described as a vicious form of taxation and one that operates with particular hardship on the sugar industry. Then comment is made on the fact that no less than 871,000 lbs. of refined sugar were imported during 1925, and this in a Colony whose main industry is sugar. One would have thought from this that there was ample scope for the production locally of a high-grade white sugar. Finally, one notes that the Commissioners are convinced that the difficulty with regard to population would settle itself if the coastal area could be made free from the danger of floods and drought, and the shortage of pure drinking water.

Development in Jamaica.

The Governor of Jamaica (Sir EDWARD STUBBS) on the occasion of opening the last session of the Jamaica Legislative Council took the opportunity to survey the state of trade and industry in that island and spoke hopefully of the prospects of development. Dealing with the agriculture of that colony he stated that considering the drought in the early part of 1926 most of the staple products had done well, with the exception of rum the exports of which fell from over 1,100,000 gallons in 1925 to less than 700,000 in 1926. Banana exports reached a record figure, while grape fruit exports showed an increase of nearly 50 per cent. over 1925. Cocoa, ginger, sugar, logwood, and leaf tobacco also showed increases. The coconut industry was also developing greatly, the exports of nuts and copra in 1926, expressed as nuts, showing an increase of over ten millions on the previous year. The essential needs of the island industries are: An increase in production, an improvement in transportation, and the finding of new markets. As regards the first need, much is hoped for from the irrigation schemes in the way of developing districts hitherto retarded for lack of water. A programme of road improvement is under consideration, and the railways are faced with the necessity of renewing their permanent way on a heavier basis, so as to carry modern rolling stock.

This summary of the Governor's remarks, which is based on a report appearing in the West India Committee Circular, suggests that Jamaica

has no intention of following the example of Cuba in concentrating on one agricultural industry. Sugar was only very incidentally mentioned in the Governor's remarks, and while the introduction in course of time of irrigation systems will probably throw open further tracts of country for cane cultivation, the present indications seem to be that no further marked expanpansion of the sugar industry is contemplated, but that, instead, a good half dozen other agricultural products are to receive major attention. In view of the weather vagaries and the droughts to which this island seems subject, this scheme of varied agricultural pursuit is probably the most sound for the Jamaicans.

Textbook Study and the Sugar Industry.

A correspondent of the *South African Sugar Journal*, who recently commented on the backwardness of Cuba as regards the scientific cultivation of sugar cane, expressed the opinion that it was largely due to a lack of any systematic study of technical publications and books on the subject. He referred to the statement that the Java Sugar Experiment Stations had accumulated a library of 20,000 volumes which has proved to be of incalculable benefit to the industry in that island. As contrasted with this was the meagre number of books he claimed to exist in the Cuban libraries, including those of the sugar mills. As a result he averred that Cuban production is still in the neighbourhood of about 2 tons sugar per acre, while Java has reached nearly 5 tons. The plaint often made in Cuba that Java accomplishes this owing to her cheap labour he dismisses with comparative contempt. To quote him on this point, "the fact that the plantings of Java are not ratooned; that her lands may remain dedicated to sugar cane but 18 months consecutively; that means of irrigating must be established for each planting, and then only partially availed of, due to insufficient water; that fertilizers have to be intelligently employed to assist in assuring remunerative crops; that the majority of known sugar cane diseases, parasites, etc., are or have been present, have been or are being fought and conquered; that sugar cane absolutely refuses to grow profitably unless its care is under the most skilled and competent direction (that costs real effort and real money); that varieties (nature-made but man-directed) have played and are playing a very important part in keeping her in the industry (this is not the product of her cheap labour); that heavy taxes and rents increase her naturally heavy burden—these drawbacks and others of like nature which constitute the mighty odds against which she has built up and maintains her industry are lost sight of, or are, perhaps most probably, not known, whereupon is made the bland remark that 'Java competes with us due to her cheap labour.'"

This is all very true, and emphasizes the fact that whatever cheap labour may have accomplished for Java at the start, it is scientific research and systematic study that have enabled her to maintain her ascendancy. And it is correspondingly true that those sugar industries of the world that are the most noted for their up-to-dateness are they who have made a practice of studying not only all that their own local industry had to teach them, but also all that was available in the shape of publications and pamphlets, issued from other quarters of the sugar world, including the standard textbooks of DEERR, GEERLIGS and other well known writers. Unfortunately in some quarters textbooks are still looked on as very much of a luxury, and when sugar is not produced remuneratively owing to competition or over-production, the demand for technical information (which one would

have supposed was the more needed then to cope with the competition) tends to fall off. Yet education should be the last thing to be starved when an industry passes through a spell of depression owing to poor selling prices, since where competition is close, those trained to more scientific methods of production are the least likely to go under in the struggle.

The American Sugar Beet Crop.

The final data of the American beet sugar campaign of 1926-27, based upon the detailed returns of all the sugar companies, show[1] that the U.S. beet sugar production of the season just ended amounted to 801,878 long tons (898,104 short tons), as compared with the 1925-26 output of 803,432 long tons (899,844 short tons). The difference in the two crops was thus less than 2000 tons although the area planted to beets was some 31,000 acres less than that of 1925. There were 79 factories at work; 758,039 acres were planted, of which 688,572 were harvested; 7,282,426 short tons of roots were paid for, of which 6,793,361 tons were worked up; the sugar produced amounted to 898,104 short tons, with an average sucrose per cent. of 14·96, average purity 83·86; the average tonnage per acre was 10·58, and 264 lbs. sugar were obtained per ton of beets; the average recovery per cent. was thus 13·22. Taking conditions for the country as a whole, the year in question approached more nearly a normal or average one than did the two previous campaigns. The beet yield per acre was less than that in 1925 (when it was 11·40, the largest since 1913-14) but was notably above the average, having been exceeded only twice in the past ten years. As in all previous years, Colorado led all the States in acreage, tonnage of beets, and sugar production; tons per acre averaged 13·88, but California was highest in average recovery with no less than 18·40.

New Sugar Duties in Japan.

A revision of the sugar duties in Japan is in course of institution, affecting both the Consumption and the Customs taxes. These, as drawn up by the Japanese Government for the Imperial Diet to approve, are given in another page, reproduced from the *Japan Sugar Trade Review.*

Our contemporary states that the most important change in the revised laws is that the limitation has been widened up to the fourth class of foreign raws, that is up to 22 D.S. inclusive, and three of the previous groups, comprising Nos. 11 to 15, Nos. 16 to 18, and Nos. 19 to 21, have been consolidated into one group. Thus all raw sugar above No. 11 D.S. and not exceeding No. 22 D.S. is to be taxed at the same rate of 3·95 yen per picul, instead of varying between 3·10 and 4·25 yen. In the consumption tax all rates are now reduced and there are fewer classes; but whereas the tax on black sugar is reduced by 50 per cent., that on refined is reduced by but 8 per cent., a distinction which will not be to the liking of the refiners who are naturally out to increase the consumption of the higher grades of sugar.

The incidence of the new Customs duties protects Formosan sugars slightly better than previously, but the enlargement of the duty restrictions to No. 22 D.S. will now allow the producers of Cuban and Java raws to offer their sugars to the Japanese refiners with every chance of ready acceptance. Our contemporary indeed opines that the result will be the importation of anything like half a million tons of Cuban raws into this Eastern market.

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[1] *Facts about Sugar.*

Fifty Years Ago.

From the "Sugar Cane," May, 1877.

In the previous few issues of our predecessor there had been little of interest from the agricultural or technical point of view, most of the space having been devoted to reports on the sugar convention and to sugar politics generally. But in the number of this month fifty years ago there appeared some matter, which still seems of some interest to recall. An account was given of experiments with Russell's maceration process[1] in Demerara in the following words : "On the Plantation Leonora, a second cane mill and macerator were added. The macerator consists of an endless band of brass cloth or net work, on which the megass from the first mill falls, and by which it is conducted to the second mill, being exposed during its passage to the action of exhaust steam from the cane engine, which it absorbs readily, and which has the effect of thoroughly searching all the cells of the megass, and melting any sugar remaining therein in the form of crystals. In addition to the exhaust steam, hot water from the condensation of juice-heaters or vacuum pans is also employed, and the two combined prepare the megass for a second crushing. . . . . . . No inconvenience is experienced in mixing the juices from the two mills, and treating them together in the ordinary way, as if they were one . . . ." Extravagant claims were made by the inventor for his process, and an increase in the amount of sugar packed of 34½ per cent., compared with the previous season when dry crushing was indicated. In spite of such assertions, however, the process appears to have induced other plantations to experiment with maceration methods.

Several patents were summarized. ROBT. S. FITZPATRICK[2] described mill rollers constructed with helical or spiral grooves round them, the grooves in one roller running in a reverse direction to those of the other. The cane was cut into short pieces the effect of this construction being to reduce the cane to a spongy pulp. Most of the other specifications related to refining processes. ABRAM LYLE[3] disclosed apparatus for moulding sugar in the form of tablets, this consisting of a drum, furnished with moulds on its periphery, revolving under a hopper containing loose sugar. Rollers were arranged to compress the sugar in the grooves as the drum revolved, and on reaching a certain point a cam action forced square pistons through the bottom of the moulds, ejecting the compressed tablets. HUGH W. WALKER[4] had a clarification process for making "clear bright syrup from residual sweet liquids" by treatment with a solution of an alkaline silicate or soluble phosphate, or a salt of aluminium, afterwards precipitated in a state of minute division carrying the impurities with it, after which the liquid was treated with animal charcoal for the removal of colour. ALBERT FESCA[5] invented a centrifugal machine, which had a series of loose rings separated by horizontal tables or discs, one above the other, arranged within the hollow cone or chamber of the machine. The spindle was supported by a flexible bearing, the upper bearing being supported by radially arranged bolts linked to rubber bands. If the basket was overcharged, the rings being swung outward by the spindle in revolving, tended to counterbalance the tendenc of the overcharged portion of the basket to pull it in the opposite direction, thus maintaining the spindle upright.

[1] English Patent, 4094. [2] English Patent 3539. [3] English Patent, 3048. [4] English Patent, 3520. [5] American Patent, 7455.

Recent Work in Sugar Cane Agriculture.

An Experiment on Drainage by means of Pumps. **E. D. Colon and J. E. Berrocal.** *Journal of the Department of Agriculture of Porto Rico. Vol. IX, No. 4, October,* 1925. ("*Issued* 1925" *but only received in* 1927.)

This experiment at reclamation appears sufficiently interesting to be shortly described, although it is impossible to enter into the complicated scientific details given in the original. The experiment covered three distinct fields, totalling 43·50 acres, on a sugar estate near the town of Barceloneta in Porto Rico, these fields occupying an intermediate position between predominantly organic (marshy) soils on the one hand and predominantly mineral (elevated) soils on the other. They were covered by a network of ditches, which had gradually been enlarged through cleaning out; and the water level oscillated with the rainfall and tide which had full access to them, while the outflows were never sufficient to drain them completely. When the tide coincided with the rains, the water level rose to the soil surface in the lowest places.

Springs of water occurred at intervals, being more abundant in the upper parts of the area. When dry, the soil showed a fine, white efflorescence on the surface, while the constant saturation of the soft subsoil caused it to be riddled with large and small crab holes, visible at the sides of the ditches. When dug up, the subsoil was of a bluish grey colour, the canes were yellowish and had many dried leaves closely adhering to the stalks, and there was a very poor stand of widely separated plants; it was impossible to misunderstand the fundamental cause of the low production, heavy annual replanting, and the shortness of the duration of the ratoons. Details are given of the production previous to the installation of the experiment, the average over the three plots for 12 years (plants and ratoons) being under 16 tons of canes to the acre. This low yield was insufficient to cover the costs of production.

A number of soil analyses were made and these are given in detail, together with those made by previous workers, and the figures are exhaustively compared with the analyses of ordinary good cane soils in various countries. The result of this comparison was to show that there was no appreciable deficiency in useful constituents and, in fact, that the soils were rich in plant food and deserving of reclamation, if this was economically feasible. Summing up, the authors consider the soil to be not a normal mineral one, as shown by the "muck" soil still apparent in places, similar to the marshes on the west, the low weight per cubic foot, the high moisture-holding capacity, the low figures for "insoluble residue" and "silicates," and the high content of volatile matter, humus, and total nitrogen.

The high percentage of lime gave hopes of improvement as soon as proper ventilation was secured. "On the other hand, there were present dangerous amounts of salts, the concentration of which would increase with improved ventilation, unless the source of the salts was cut off, by preventing the tides from getting into the plot, and the bad effects of evaporation were counteracted by the washing accomplished by rainfall. There was, besides, one other hope of compensation in the constant flow of almost fresh water derived from the springs, which might at any time be used to advantage for their amelioration." It was accordingly decided to try as an experiment the exclusion of the tide waters, and the pumping out of the water from the springs, seepage and rainfall, using the least possible number of ditches to lower the cost of the pump installation.

As a preliminary experiment, 4-5 acres on the higher ground were taken in hand. The deep and wide ditches were filled in, and new shallow ones

opened up, and POJ 105 and, to a smaller extent, Striped Cheribon were planted on banks of two rows each. The pump did not affect the field until the crop was half grown, and the yield was 34 tons of cane to the acre. Encouraged by this result, the remaining 38½ acres were taken in hand on "gran cultutura." The ditches were all filled in, excepting the one round the whole area and a specially wide canal 3-4 ft. deep on low land, which could be used to great advantage for collecting the water to be pumped. Although after filling the ditches the land was rather soft, it was found possible to plough and cross plough with bulls drawing a mouldboard plough, after which a tooth harrow and disc harrow were used. Furrows were then ploughed 5 ft. apart, and one row canes were planted in a furrow on the banks thus made; and a new system of ditches was installed. POJ 105 was then planted in continuous rows, in order to test the reported good results obtained with this cane. After a careful study of the duty of the pump, it was installed at the lower end of the canal mentioned above. The results were above expectation and, at the end of 14 months, 980 quintals of canes were reaped to the acre (about 50 tons). The paper concludes with a statement of costs. The full expense of the pump installation is given as $3,546·21, this to be paid off in five years. The 2000 odd tons of cane produced cost $2·72 per ton, or including amortization of the pump expenses, $3·07.

THE MOSAIC DISEASE OF THE SUGAR CANE AND ITS CONTROL IN JAMAICA, **C. J. Hansford and P. W. Murray.** *Department of Agriculture. Jamaica. Microbiological Circular, No.* 8, 1926.

The title of this paper is somewhat misleading, in that it is of much more importance than is usually indicated by the descriptive word "Circular." It is, in fact, a concise compendium extending over some 40 pages on the Mosaic Disease in general, with addenda as affecting the Jamaica cane-fields; and may be read with advantage by every planter who is troubled with this disease. It commences with an excellent summary on the disease itself, from its first discovery in Java, and dealing with a selected literature of 34 more important papers. HANSFORD, the writer, concludes with a list of measures which have been found of practical value, and which are clearly explained for the benefit of the local planters. The necessary precautions in selecting the seed for planting, the limits within which roguing will be of advantage, the relative treatment of fields with slight and severe infection, and the final clearing up of the estates when necessary by uprooting the canes being grown and replanting with Uba for a term of years, are described in short paragraphs. For the latter purpose, the estates should first be divided into a number of large continuous sections, each of such a size that it presents the maximum area which can be properly dug out and replanted in one season. For replanting, after treatment a special disease-free nursery should be instituted, and the various sections under Uba should be dealt with in the same order as before, always maintaining a continuous belt of Uba between any new fields and those still to be treated, and very carefully examining them from the start, and roguing them when necessary.

The second paper, by MURRAY, details the field experiences in the control of mosaic in Jamaica, 1923-25. After giving the history of its first discovery in 1920, the conditions in each parish are described and tabulated after the surveys of 1920, 1923 and 1926. In 1920 it was found that the disease was present in almost every cane growing district, and that the infection was very severe in some places. The Government nursery at the

Hope Experiment Station, from which plant cane was being distributed, was also found to be severely infected. Wide publicity was given of the nature of the disease, the losses incurred and the current remedial measures. Early in 1923, the Department of Agriculture realized that the disease was steadily gaining ground on almost every estate in the island, and that the control measures were not being properly carried out. A second survey was therefore made, and meetings were held in various parts of the island. A law was passed enforcing treatment of diseased fields, and the growing of maize in the same fields as sugar cane was prohibited. Nurseries were established to provide tops of Uba cane and mosaic-free tops of the ordinary canes grown. Inspectors were appointed and the Superintendent of Agriculture was placed in charge of the whole campaign. The results of this campaign are best judged by the tabulated statement of the conditions in the different parishes in 1923 and 1926 ; everywhere a considerable reduction had been effected, and in most parishes the infection was below 1 per cent. In the three parishes where the infection still reaches 5 per cent., Uba was being planted.

In reviewing the value of the different methods of control, roguing is given the first place ; but it is also pointed out that the efficiency of this practice depends very largely on the personal element, both of the management and of the labourers. The Agricultural Department therefore advocated payment by result, a system devised by a planter in Trelawney, and this was found to be highly effective in overcoming the difficulty. After the first three roguings had removed all cane plants with primary infection (handed down by the parents), it was found unnecessary to root up whole clumps, as it sufficed merely to cut out the individual canes attacked. For roguing to be effective, it was found that it should be frequent, at least once in ten days but preferably once a week. Where an infection of 10 per cent. was noted, it was found to be economic to allow the canes to mature and then mill them ; to dig the roots out, and then to allow the land to lie fallow for a short period, so as to permit of the very thorough removal of all remains of the cane plants on the field, before replanting. In one parish, the interesting fact emerged that canes planted in the autumn were much less liable to be attacked than when planted in the spring, and fall planting is now here the rule. A similar experience is reported from Cuba.

As planting up the whole estate with Uba for a time is the final resort, it is fitting that a third paper should be devoted to a thorough study of the behaviour if this cane variety in Jamaica, also written by MURRAY, the Superintendent of Agriculture. Uba was introduced into Jamaica in 1916, and has rapidly extended, especially in poor lands, and, latterly, in connexion with the fight against mosaic. There were at the time of writing 6000 acres planted, and this area was being considerably increased. This paper is of considerable value, as it gives numerous details as to the local experience both in the field and factory ; and the results agree very well with the general opinion held of this class of cane. A series of letters from planters is printed at the end, giving their experiences with Uba, some for and some against, and very well summarizing its merits and demerits ; and there appears to be no great danger of many planters adopting the cane permanently if they can grow canes of a better class. The little or no cultivation required, the heavy yield under unfavourable conditions, and the freedom from disease are all in its favour ; while its fibrous nature, less juice, difficulty in harvesting and milling are on the other side. The adoption of Uba as a crop cane will therefore be largely determined by the character of the soil and

climate, and the financial position and economics on each estate. A short note is added at the end of the Circular describing Streak Disease, which has been contributed by H. H. STOREY on request.

MOSAIC AND STREAK DISEASES IN INDIA. *Scientific Reports of the Agricultural Research Institute at Pusa, 1925-26; Report of the Mycologist.*

During the year, mosaic was found for the second time in the sugar cane plots at Pusa, the previous occasion having been in 1921. A comprehensive search was accordingly made throughout the cane growing tracts all over the country. The disease was found in Bihar, the United Provinces, the Punjab, Madras, Bombay, Central Provinces and Burma; and lists are given of the canes found to be attacked. These lists appear to be in all cases from Experimental Stations, excepting in Bihar where several estates are included. The infected varieties include tropical canes, Java crosses between these and North Indian canes, and Coimbatore seedlings of a somewhat similar nature. Only one cane indigenous to India is mentioned, Hemja, the main native crop cane in Bihar. It is hardly likely that other Indian canes will not be added to the lists as the enquiry proceeds.

Only leaf mottling has been observed, and the other secondary symptoms have not been noted. Particular attention was paid to the Coimbatore seedlings, many of which are affected, while many others have not as yet shown the characteristic markings. In these seedlings the infection usually appears to be slight, but Co 232 was noted as being fully infected in several places; the figures given for others grown on a sufficient scale were: Co 250 20 per cent., Co 287 15 per cent., and Co 210 and 213 5 per cent. Losses in Co 213 and 210, grown on a large scale were not apparent, and the infected canes did not appear to be smaller than the healthy ones; these canes would thus seem to behave similarly to the Java crosses, i.e., as carriers, although infected to a much smaller extent. Mosaic was not found at all on the Co 214, as with many other Co seedlings but as the latter were only grown on small plots, the evidence is thus far merely negative.

Ot the thick canes examined, Red Mauritius, Purple Mauritius, B 6308, Mauritius 16 and A 2 were always fully infected. Hemja was heavily infected throughout Bihar, usually very stunted and likely to give a light yield of canes. Comparative plots have been instituted to gauge the losses incurred in three varieties. Roguing has also been introduced, but results are not as yet available. Red Mauritius and several Co seedlings have shown the usual transmission of their characteristic mottlings on being cut up and planted. The disease has been transmitted by juice pricking in Co 213, and also from Red Mauritius to Co 213. The latter experiment is specially interesting, in that the much more conspicuous markings of the Red Mauritius leaves have also been transferred to the Co 213 treated in this way; this suggests a differentiation of virus in different kinds of cane.

An assistant sent to the United Provinces and the Punjab to search for mosaic observed certain Uba leaves with the characteristic markings of streak disease. Cuttings brought to Pusa and planted distinctly showed this disease. "Over the whole surface of the leaf occurred numerous narrow, pale stripes running in the direction of the veins of the leaf. Each stripe was a quarter to half a millimetre in breadth and nearly uniform, while in length it varied from half a millimetre to a centimetre or more. They showed up most clearly in the newly expanded leaves."

A study of the insect vectors of mosaic disease in the sugar cane will presumably be taken up in due course in India, but we find no reference to it in the present report.

C. A. B.

The World's Sugar Consumption.

The Increase to be expected during the next Decade and the Capacity of the Different Countries to produce it.

By RUDOLF E. GROTKASS.

(*Continued from page 193.*)

Cane Sugar Countries.

After the review of the world's sugar beet territories given last month, the analysis of the sugar cane regions of the globe naturally follows :—

Cuba.—The total superficial area of the island is 28,264,960 acres, three-quarters of it being land capable of cultivation. Mr. H. Rubino of the Miranda Sugar Co., representing the interests of the American sugar producers in Cuba at the hearing before the Senate Committee in Washington in 1921, made the statement that land capable of bearing cane, owned or controlled only by the American interests, amounted at that time to 4,459,407 acres. This enormous area is not yet all under cultivation. The plantings in cane are estimated at 2½ million acres, while, according to another estimate, it is supposed to be 3⅓ million acres with a sugar yield of 1½ tons[1] to the acre. While the technical performance of the Cuban Centrals has been developed to high efficiency, the methods of cultivating cane are still capable of a lot of improvement, if we look at the rather moderate sugar yield per acre. As a comparison it may be stated here that the average sugar produced per acre in Germany had attained before the war to two tons (in one particular year even to 2·2 tons per acre) and this with a vegetative period of only six months against 12-15 months in Cuba. While in the adjacent region of Porto Rico great amounts of fertilizer are being used, Cuba is doing without it and thereby draining continuously her available soil nutrients. The capitalistic organization of the Cuban sugar industry with its large holding of land permits of course a more rapid introduction of fertilizing methods if once recognised as necessary, than would its introduction into territories where agriculture is not so subject to organization. The great stretches of still available lands, as well as the systematic application of fertilizers to augment the present comparatively low yields, coupled with better methods of cane cultivation, are factors which permit a further increase in production to a still very large extent. When in the campaign of 1905-06 the output exceeded one million tons, most of the European experts were decidedly sceptical of any further rise. All possible arguments were brought forward, such as lack of labour on account of the sparse population, competition from other crops, and lack of capital owing to too high rates of interest. In 1905, Paasche, a German investigator of reputation, considered any increase to 5 or 6 million tons as fantastic. Ziegler, in Austria, took the same stand even as late as 1914. Julius Wolf was the only authority in Europe who, relying on reports from foreign sources such as from the American Consul Steinhart in Havana, opposed the prevailing opinion in European sugar circles, and considered the Steinhart estimates of 5 to 6 million tons as perfectly reasonable. He also recognized the beginning of the supremacy of cane sugar production over beet sugar. The changing point in the superiority of beet sugar was not the world war as was generally supposed, but the Brussels Convention of 1902. But to revert to Cuba. Against the prevailing opinion in 1905 and 1906, the Cuban output passed the 5-million ton mark in 1924-25 after it had already nearly doubled before the war. Again, the following campaign achieved nearly the same figure. This tremendous increase in production began to create alarm

[1] Tons in this article are metric (2204 lbs.) unless otherwise stated.

even in Cuban circles and a dangerous depression of the sugar market loomed on the horizon. The Cuban government thereupon decided to take measures of control and passed an Act, enabling the President to fix every year a quota permitted to be produced by the Cuban sugar mills. This regulation came into force this year, as is known, and the output was fixed at 4,500,000 tons. This Act need not be considered as a retarding measure in the development of the island's sugar industry, but is solely destined to regulate its development according to the prevailing market conditions. In consideration of the situation in Cuba above outlined a further increase of 3 million tons for the coming decade is quite feasible.

British India.—The area in sugar cane for several years past has varied from 2½ to nearly 3 million acres. About 200,000 acres are planted with sugar palms. The total production of sugar has averaged something over 3 million tons with the low per acre production of 1 to 1½ tons. By far the larger part of this is not sugar in the Western sense, but a product called *gur* polarizing between 70° and 80°. The British Government as well as private interests have made great efforts to improve the technical efficiency of the many little old-fashioned mills as well as the cultivation of the plant. The results, though, have been rather discouraging, due to the ultra-conservative behaviour of the rural population. In the near future no particularly large progress can be expected in India. Some 500,000 tons more is, therefore, an appropriate quantity to be reckoned with, despite the enormous possibilities. But this addition will not influence the sugar market but simply be absorbed at home.

Java.—According to the figures for 1925 of GIJSELMAN and STEYN the total plantings in cane were 440,000 acres (1922, 395,000 acres), which produced a record sugar yield of 5·02 tons per acre in 1925-26. The apparently higher yields obtained in Hawaii are due to a 20-24 months' growing season, with raw sugar produced, whereas in Java 12-15 months is the rule and two-thirds of the product being white sugar. The cultivation of sugar cane, as well as the manufacture of sugar, has here been developed to a high degree of perfection. Particularly has the selection of resistant, heavy-yielding, strains of cane made rapid progress. In 1914-15 1,400,000 tons of sugar were made, in 1924-25 as much as 2,300,000 tons, with an estimated 2 millions for the last campaign. Nevertheless, further progress cannot be maintained at that rate. On the technical side there is not much left to improve. Besides a possible increase in plantings, other chances for improvement seem to lie in that further selection of disease resisting varieties which is well under way. Therefore an increase of 500,000 tons above last year's figure seems to be the maximum likely until 1936-37.

Brazil.—This is a country of the size of the U.S.A. which has attained to fourth position amongst the cane growing regions. Production before the war ran around 200,000 tons, and has risen to an estimated 800,000 tons according to LAMBOTNS figures for 1926-27. The country has 160 mills operated by steam power and a countless number of small wooden roller mills. The Brazilian industry could with the high sucrose content of its cane raise its sugar output considerably by merely improving the technical extraction methods. But the agricultural possibilities are practically unlimited. The tropical climate, abundant rainfall, the rich alluvial soil, the great river system coupled with enormous stretches of land adapted to growing cane will make Brazil at some later day the sugar box of the world. But before this happens a lot of water will have run down the Amazon. The big capital needed to open up these lands to cultivation must come from outside, as must the human material for colonization. To-day the leading American sugar capitalists are more interest-

ed in the West Indies and the Pacific islands which from their situation and the nature of the American sugar tariff offer more of an inducement to the investor. But, for the time being, in Brazil 500,000 tons may be counted upon as the minimum extra output.

Philippines.—In 1910 205,000 acres were planted to cane and in last year's figures from 560,000 to 600,000 acres were reached. The output of sugar and *panocha* (a product similar to the Indian *gur*) mounted from 150,000 to 581,000 tons in 1924-25 and is estimated at 525,000 tons for the current crop of 1926-27. Apart from occasional droughts and cyclones the openings for this agriculture are very extensive. To-day the sugar industry of the country enjoys the protective tariff of the United States, and would find a wide market in the Far East for its sugar if the political situation were to improve. Under these conditions an extra production of 300,000 tons may be assumed.

Hawaii.—Upon this peculiar group of islands in the Pacific Ocean, belonging to the U.S.A., cane cultivation and sugar manufacture have developed to the highest point of efficiency in all tropical countries, Java excepted. Here are united the most favourable agricultural conditions such as rich soil, rainfall, irrigation systems, unlimited vegetative period, with tariff protection, waterways, capital, and the enterprising pioneer work of the white North American. The name of KLAUS SPRECKELS, born in the province of Hanover, Germany, is linked for ever with the laying of the foundation of the present industry. In spite of the sceptical views expressed by ZELLER in 1920, the output has risen from 500,000 tons to nearly 800,000, while the acreage devoted to cane has remained constant at about 240,000 since 1914. The actually harvested area is only one half of the total, due to the growing period lasting about two years. About half of the territory has sufficient rainfall, while on the other the cane is grown under irrigation. The average sugar produced per acre is 5·75 metric tons, but calculated on the harvested acreage only. The average yield for that half of the region which resorts to irrigation has been as much as 7 tons. These extraordinary figures have been obtained under a most highly developed system of cultivation, nearly two years' vegetative period, the extensive use of fertilizers, selected cane varieties, systematic measures against plant diseases, and with machinery, chemical control, and an operating staff of highest efficiency. Here, according to human calculation, all possibilities for a further increase must be considered as exhausted.

Japan and Formosa.—Besides four beet sugar factories upon the island of Hokkaido, Japan has a cane area of 80,000 acres. In 1895 Japan took over the island of Formosa from China. Under Japanese influence the sugar industry became modernized and achieved a most rapid development. The plantings rose from 61,000 acres in 1904-05 with variations up to 561,000 in 1921-22. The production of raw sugar in Japan and Formosa during this period rose from 120,000 tons to nearly 600,000 for 1925-26, while 530,000 tons are estimated for 1926-27. An increased output to 700,000 tons can be looked for only by bettering the present low yields per acre and always providing the political situation in the Far East does not take a turn for the worse.

Haiti and San Domingo.—This island, divided into two territories, was the centre of the world's sugar production in the 18th century, until the great tidal wave of the French Revolution reached the island and completely annihilated its social and economic structure. Then the cane sugar industry disappeared for the time being. In 1905 the United States took over the control of the finances in San Domingo. Sugar production at that time was as low as 55,000 tons. The island, which is about two-thirds the size of Cuba, is

similar to it also in respect of soil conditions. The influence of North American capital has been quite stimulating upon the output of the industry, which has passed 350,000 tons for the two last campaigns. The future chances can be considered as extraordinarily favourable, a further increase of 300,000 tons under the benevolent supervision of the Americans being quite likely.

Porto Rico.—Since 1916, plantings in Porto Rico have risen somewhat, from 203,000 acres to about 240,000. Production from 448,600 tons to 590,000 tons for 1924-25 with an estimated 560,000 tons for the current campaign. The last few years plantings have been quite constant. The imports of fertilizer are heavy, amounting in 1925-26 to 3 million dollars in value. Cane cultivation has attained a higher degree of perfection than in the neighbouring island of Cuba. The acreage planted to cane amounts now to about 40 per cent. of the total cultivated area, and if no additional irrigation projects are launched in the South (a not too likely contingency) any particular increase above 600,000 tons cannot be looked for.

Australia and Fiji Islands.—The cane area harvested in Australia stood until 1919-20 around a figure of 100,000 acres, with a production showing strong variations in the cane yields of 129,000 to 325,900 tons of sugar. The plantings have since been increased and reached in 1923-24 176,000 acres. The sugar production in the following year came up to 528,000 tons, but the estimates for the current fiscal year are only 390,000 tons. Due to Australian legislative restrictions only white men are employed in the sugar industry, which makes labour an expensive item in the cost of producing sugar. Only a small strip along the coast of Queensland and some stretches in New South Wales are adapted to cane cultivation. On account of the high cost of production, the output of the country could only be developed under great difficulties above the maximum production of 1925-26. Also the high *per capita* consumption of 120 lbs. has about reached its saturation point, and is covered entirely from home production. Similar is the case of the Fiji islands.

Argentina.—The output in Argentina has seen many ups and downs on account of the uncertain climate. As far back as 1914-15 336,000 tons were manufactured in a season, but low levels of 100,000 tons and below have also been reached. The last crop amounted to 486,000 tons . . . . but does not merit its apparent importance owing to the hitherto fluctuating development. At present some interest is being shown in the attempts to grow sugar beets, which for Argentina as well as for her neighbour, Uruguay, may some day become of vital importance. The cane sugar industry, developed under a protective tariff, is not expected to top the high mark mentioned above, as the home consumption is already provided for.

Peru.—With the total absence of rainfall along the cane growing coastal regions, irrigation is necessarily practised. The even climate permits a vegetative period of about two years as in the Hawaiian islands. Cane cultivation has been developed to a high degree with the use of large amounts of fertilizer available from the nearby guano and nitrate deposits. The mills are modern and efficient. Since 1914-15 production has risen from 175,000 tons to 350,000 tons in 1920-21 and has since kept at figures from 250 to 320,000 tons. The total cane area in 1924 amounted to 140,000 acres of which 70,000 acres were harvested. As production totalled 310,000 tons in that same year, a yield per acre of nearly 4½ tons is obtained. For any further extension of the cane plantings new irrigation systems will have to be built. Suitable territories are still available to a certain extent. A development of production up to 450,000 tons can then be counted upon.

Mexico, Central America.—After the succession of revolutions following the overthrow of the Diaz regime, the Mexican production dropped from 150,000 tons to 40,000 tons in 1917-18. Then the recovery started. Recently the present Government has taken a more favourable attitude towards the former disowned cane planters, and this should be of further beneficial influence upon the recovery. The present output is estimated at 175,000 tons for 1926-27. With all absence of internal strife 300,000 tons ought to be attained considering the great all round possibilities. The same may be said of the other Central American Republics. Since 1921-22 these regions have shown an appreciable increase. The output rose from 20,000 tons in 1919 and 1920 to an estimated quantity of 140,000 tons for the last campaign. The growing influence of the United States is a favourable economic factor and a further increase of 100,000 tons is a reasonable possibility.

Mauritius, South Africa, Egypt.—There has not been any particular change in the growth of the industry in Mauritius and Egypt during the last ten years. and there is no reason to expect one in the near future. On the other hand. the progress made in Natal since 1914 is worthy of attention. The output rose from 91,000 tons to an estimated 220,000 for the campaign of 1926-27. A further increase of about 100,000 tons can be safely estimated.

Production in Portuguese East Africa does not seem capable of much progress, to judge from its past record.

The French colonies of Réunion, Martinique and Guadeloupe have for a long time been constant in their production and are expected to remain so.

China.—According to the meagre statistical reports available, the southern part of the Empire produces a quantity exceeding 300,000 tons. The unsettled conditions of the country do not however permit any estimate to be made at present.

British West Indies and British Guiana.—The most important of the British West Indian possessions are Jamaica, Barbados and Trinidad. For many years production has been quite constant with figures between 100 and 200,000 tons. The cane plantings as given by the British Trade Commissioner cover 145,000 acres. The production of Demerara (British Guiana) keeps also constant with about 100,000 tons, but is being checked through the prohibitive measures, passed by the East Indian Government, against the emigration of coolie contract labour. Since even the world war has not been able to stimulate the sugar industry of these regions, there is no particular reason to expect at present any noticeable progress for the next decade.

Louisiana.—This territory belonged not so long ago to the great sugar producing regions of the globe. Despite the favourable influence of the Great War on the cane sugar industries, the decline of that in Louisiana has assumed the proportions of a collapse. The pre-war figures of 300,000 tons and more have never since been repeated ; the output has dropped frequently to 100,000 tons and lately even much below this figure. The financial situation of the industry is desperate. The Government has started trials with sugar beets as a possible remedy. General crop failures, mosaic disease, etc., are the arguments advanced to explain the decline. The real reasons lie much deeper; undoubtedly the wasteful methods followed in agriculture, especially soil treatment, are greatly responsible for the present state of affairs. If the Federal or State Government decides to give a helping hand financially, to save the great amount of capital invested, and succeeds in reorganizing the obsolete agricultural methods, it might be possible to attain once more a production of 200,000 tons. But without some such energetic measures, no improvement can be expected.

Venezuela and Ecuador.—In these two States, and in several other South American Republics, exists a small sugar industry. How far this will be capable of development depends upon the influx of foreign capital, which so far is not in sight for any such purposes.

ADDENDA.

Russia.—The exact figures for the acreage (harvested) for 1913 and 1914 are 707,645 and 785,522 ha.; the planted acreage for 1914 attained the record figure of 845,626 ha. Sugar production from the harvests in 1910 and 1911 brought the record figures by slightly exceeding 2 million tons in both years.

Czecho-Slovakia.—The sugar production in Austria-Hungary from the high 1912 acreage of 448,000 ha. brought a maximum figure of 1,901,616 tons, of which according recent official information 320,000 ha. were laying within the boundaries of the present republic with an estimated production of 1,450,000 tons

CONCLUSION.

The total sums of the estimated future potential figures of production for the individual sugar beet and sugar cane growing countries show for beet sugar an increase of about 4 millions, and for cane sugar one of about 6 million tons, as shares in the estimated possible increase of 10 million tons in the world's sugar production, making a round 34 million tons for 1936-37. As shown above, this 10 million ton increase can be obtained without great exertion.

While the present ratio of production between beet and cane sugar stands as 1 to 2, the *proportion in the increase* will be more like 2 to 3, thus bettering somewhat the position of beet sugar.

Besides the countries reviewed here, Southern Siberia and the provinces of Shantung, Shansi, Honan, South Chili, and Manchuria in China, as well as possibly Korea, possess vast territories of land suitable for sugar beet culture, while Mesopotamia, and parts of Africa, as well as many of the great islands between the Malacca Straits and Australia, have great tracts of land suitable for cane growing. But for the period discussed in this paper, they cannot be considered.

The possibility of influencing the world's sugar output through new technical improvements is rather limited. Of vital importance there would only be the solution of the problem of harvesting machines for both beet and cane fields, as well as the development of a practical process for the desugarization of cane molasses.

But it is necessary to repeat that these estimates for the coming decade, comprising in detail the entire world's sugar industry, probably undertaken for the first time, are potential figures only, and that all the other adventitious factors, such as political complications, bounties, and duties, weather conditions, and natural catastrophes, cannot be calculated in advance as to their possible influence. Nevertheless, what has been given above should serve its purpose of outlining the possibilities offering themselves in the coming tussle between beet and cane sugars, and should reveal those quarters from which the strongest competition is to be expected, and so allow the necessary preparations to be made to meet it.

The Sugar Section of the British Empire Producers' Organization has been formed into a federation, with the object of offering a united front to the highly-organized competition of American and Continental producers and refiners. The new federation represents the entire sugar producing industry of the Empire.

The Lahaina (Otaheite) Cane.

By NOEL DEERR.

The *International Sugar Journal* in its issue of last December[1] quoting from Mr. H. P. AGEE's article on the Root complex of the Lahaina (Otaheite) cane gives some historical account of the wanderings of this cane. To this article some notes on its presence in India may usefully be added here.

In 1827 this cane was introduced into India from Mauritius by Captain SLEEMAN. At this time SLEEMAN was a subaltern in the service of the Honourable East India Company and from extant references he would appear to have engaged in sugar production, being apparently interested in a plantation near Jubbulpore. The great part of his career in India was spent in political service and he is remembered as that officer to whom the suppression of Thuggee is due; he died in 1857 on the voyage home shortly after having been awarded the K.C.B. The cane SLEEMAN introduced has become extraordinarily widely distributed in India, and the present writer has met with it in Hyderabad (Scinde), Lahore, Gwalior, Cawnpore and Lucknow. Near all these cities, it is grown as an eating vegetable under intensive market garden conditions or, to use the American expression, "truck farming."

From India proper this cane was brought to Burma in 1840, and it still remains under extensive cultivation there where it is known as Toungoo Yellow and *Zewaddia*, two localities where the cultivation of sugar cane for Gur manufacture has some extension. But it is on the North-West Frontier that this cane has received its greatest extension in India and under conditions which would be predicted as impossible for a variety of this type. In the Kabul Valley in the vicinity of Peshawar, in latitude 34°N and at an elevation of 1100 ft., it is the principal cane grown, and the total production of Gur from this locality amounts to about 30,000 tons annually; and it is also grown in Swat and in Kohat. The conditions here are peculiar and include a fertile soil, and an intensely hot and dry summer with the temperature rising to 125° F. in the hot weather. Combined with this is an ample supply of irrigation from the Kabul and Swat Rivers and the presence of a virile population who are all skilful cultivators and irrigators of many generations of experience. In Peshawar and elsewhere in India, there occurs, mixed with this cane, and of somewhat similar habit, another "Paunda" cane. Generally these two canes are not differentiated but are referred to conjointly as "Paunda." Both these are distinct from the cane grown in the Nira Valley and elsewhere in Bombay under the name Pundhya, the Mahratta dialect form of Paunda, and which itself is a noble cane of excellent habit and characteristics.

In addition to the localities quoted in the article referred to, Brazil Argentina, Spain, the Philippines and Java should be included as places where this cane has been a standard and valuable variety.

As AGEE has pointed out, the history of this cane has been generally a period of great success followed eventually by a gradual decline in production, culminating in a fulminant outbreak of disease, as exemplified in Mauritius, the West Indies and British Guiana, in various parts of India, in Hawaii, in Brazil, and possibly elsewhere if records were available to make the statement. In older days "degenerescence" due to continued asexual propagation was the theory put forward to account for this sudden failure. That this theory is unsound is evident when it is remembered that this cane was giving its best results in Hawaii when it had already "degenerated"

[1] 1926, 648.

in the West Indies, Mauritius, and elsewhere. All this cultivation must have been asexual descendants of the original stool and may thus be considered in a sense to have been the same individual. Writing as an ignorant layman, it would appear to the writer that the cause of the degenerescence was the gradual infection of the stock and of the soil with pathogenic organisms, which, in time, developed towards this particular variety strains of specific virulence, resulting in the fulminant outbreaks of disease already referred to above. After the absence from a district of this variety for a number of years, the specificity of these strains may have diminished and on re-introduction the variety's success may reasonably be anticipated. Presuming, as seems established, that the varieties Otaheite and Louzier are identical, this is what has obtained in the past in Mauritius, the Otaheite as Louzier being re-introduced about 1870, 20 years after the epidemic which attacked the Jaune de Otaheite.

While the writer has ever supported the extension of cane breeding work, he thinks it would be a mistake to altogether abandon a cane of such a distinguished record, and he believes that in those areas where it has done so well in the past, it would be well worth while to try out this variety again, using a disease-free and selected stock, on lands which have been occupied by other crops or other varieties of cane for a number of years.

The 1926-27 British Beet Sugar Campaign.

Results of the Anglo-Scottish Group.

Below we give a tabulation of the results achieved last campaign by the factories in the United Kingdom of the Anglo-Scottish beet sugar group, as supplied to us by the Corporation.

The general conditions of the beet fields during the season in question were on the whole good, except for the abnormal quantity of "bolters," due no doubt to the late ground frost experienced in the Spring. Farmers now are taking greater care in the preparation of their land at this time than was the case even two years ago, but much closer attention is still necessary when the "gapping out" and singling work is undertaken to ensure a far better percentage of stand and no blank spaces in the fields. The farmers can grow excellent quality roots, which if anything are on the large size in some districts. The average yield per acre from the whole of the crops under review was approximately 9 tons, with a minimum of 3 tons and a maximum of 20 tons. The deliveries showed a much better tare and were freer from obstacles than formerly.

DATA COVERING THE 1926-27 CAMPAIGN.
(Weight in Long Tons).

Factory.	Average Sugar Content of Beets.	Tonnage of Clean Beets Purchased.	White Sugar Bagged.	Molasses Yield Per cent.
Colwick	17·3	84111	12672 (includes Molasses Desugarisation Plant)	3·8
Kidderminster	17·8	54,832	7666	3·9
Spalding	16·6	50,911	6369	4·0
York	17·5	54,703	7263	3·6
Felstead	17·8	33,072	4409	3·6
Cupar	17 1	22,226	2522	3·3

A.C. versus D.C. for Variable Speed Electrical Mill Drives.

By L. B. WHITAKER.

Mr. W. P. ABENDROTH, A.I.E.E., has given[1] a very interesting contribution to the important question as to which type of variable speed electrical drive would prove the most suitable for driving cane mills. To judge by his concluding remarks it may be imagined that the D.C. drive has already been applied for this purpose, and if this be so it would be highly instructive to obtain some information of its actual performance regarding the high efficiency, adaptability and flexibility that is claimed for it, also giving due regard to the first cost of such an installation as compared with an alternating one.

Mr. ABENDROTH tells us that the D.C. drive has been developed because there are no alternating current motors suitable for variable speed driving of cane mills, and if this were so it would certainly be a very cogent argument in favour of it.

He agrees that variable speed may be obtained by the use of A.C. motors, but cites the older systems only, i.e., secondary rheostatic control and frequency variation, the first being admittedly inefficient and the second unsatisfactory, as it splits up the factory supply into a number of isolated systems of varying frequencies; besides which, it will not give individual mill speed variation.

The most applicable form of A.C. variable speed motor, the "single field" cascade type, he is evidently not familiar with, as in mentioning it he refers to the ordinary cascade application consisting of two separate motors which must be in some way mechanically connected with each other.

In the "single field" motor, which is of comparatively recent development and embodies some important British patents, these two motors are in effect incorporated within one frame by means of a special system of winding, the function of which was indicated in a previous communication. This machine being a self-contained unit is not dependent for its operation on any other motor in any way, either electrically or mechanically, so each mill coupled to it could be driven quite independently of the others. Such motors can be used for any drive where variable speed is required, and a typical example of this type in a drive analogous to that of a cane mill may be found in a French steel works, where one of these "single field" motors drives a rolling mill at speeds varying between 247 and 367 r.p.m. The B.H.P. exerted is 465 at low speed and 700 at top speed, the corresponding power factors being 79 and 91 respectively and the efficiency 90 and 93 per cent., respectively.

It should further be noted that this development of the cascade system results in a motor similar to a wound rotor induction motor and consequently avoids the expense of the D.C. commutator and has the advantage over it that it can run in ordinary mill house conditions without having to be enclosed, as a direct-current motor would have to be to avoid commutator trouble.

The writer is able to state that a scheme had been formulated to apply this type of motor to a cane mill at present driven by ordinary induction motors, but the matter had to be shelved owing to the recent depressed conditions in matters pertaining to sugar. There is little doubt however that such a drive will sooner or later be adopted, when it is to be hoped that full particulars of its operation and cost will also be available for comparison with other methods. With this form of A.C. drive in view it certainly would appear

[1] *I.S.J.*, 1927, pages 82-84.

that the necessity for the use of direct current must be made more apparent before a factory's electrical supply is cut up into two systems.

From Mr. ABENDROTH's remarks about geared turbines, it would appear that he also agrees that the direct coupled D.C. turbo-generator would prove unsatisfactory, and here again the D.C. drive must be fully justified before factory owners are asked to abandon the comparatively cheap and simple direct-coupled high speed turbo-alternator in favour of the more expensive and probably less efficiently geared unit, which would be more expensive on account of the extra cost of the gear and that of the larger slow speed D.C. generator, the most expensive part of which is the commutator. The extra losses due to the gear would be about 3 per cent. with the best self-generated type.

Referring to the question of one prime mover driving several different forms of generators, this is, of course, nothing new, such machines having been used for special purposes for the last twenty years at least; and while the driving of the house auxiliary generator and exciters, etc., by one turbine may be quite satisfactory in a New York power-house, where these units are doubtless covered by spares and form but a subsidiary part of the whole plant, the position in a sugar factory is very different, and the suggestion that the entire plant from the cane unloaders to the bagging machines should be dependent on one large prime mover would not, it may be imagined, be regarded with equanimity by any Factory manager responsible for the uninterrupted running of his plant during the period of the campaign; and even if he were in favour of the electrical drive in regard to its application to the various units in the factory, he would surely rather re-adopt the old individual steam drives than take such a risk of a complete breakdown.

If we are to look for reliability of power generating plants we should turn to municipal undertakings where we invariably find as standard practice the provision of a reasonable number of separate power units as is necessary to economically deal with load variations, together with one or more sets kept as a stand-by in case of breakdowns.

As an alternative to using one prime mover, there is no necessity to run a multiplicity of units at varying loads and frequencies, for, provided A.C. current is used throughout the factory, the generating units can be of the same size and interchangeable, and run in synchronism, therefore at the same frequency; and this gives complete flexibility and adequate insurance against breakdown, as one spare set would cover the possible failure of any one unit.

With regard to the necessity of running turbines at their most efficient output, the proper selection of units to take care of such load variation as exists when one or more trains of mills are not grinding, or during boiling off periods, will ensure this better than will one large turbine running at full load only when every motor in the plant is turning; but this question of turbine efficiency loses much of its point so long as turbines requiring around 50 lbs. of steam per K.W. hour are being installed in order to supply sufficient exhaust steam for the factory's thermal needs. If turbine steam consumption figures are to be improved a radical change in the type of machine at present commonly used must be made.

My suggestion regarding the use of a motor generator has evidently been misunderstood, as its main object was to provide direct current without resorting to the mixing of the Power House generation systems and always assuming that the installation of D.C. mill motors is really a necessity. This

special type of converter was mentioned on account of its simplicity and ease of operation, but if efficiencies are the prime factor there is nothing to prevent the installation of a rotary converter, or, if a system is needed having a maximum of efficiency with a minimum of attention, a mercury arc rectifier could be used. These lately developed appliances are thoroughly proved and have been in use for some years supplying direct current to the Paris underground railways; and as regards efficiency of working, a 500 K.W. 3-phase rectifier at 460 volts, 50 cycles, operates at an efficiency of 94 per cent.

The question of power factor improvement was introduced to show how a motor generator (or rotary converter) might be used to help in improving the general efficiency of the system should the power factor of the plant require correction, and also always assuming that the provision of direct current for the mill motors is necessary.

It would be very useful to have reports from engineers and others operating electrically-driven factories, of what the power factor of their plant is; for although a properly designed motor with a minimum air gap and using ball bearings should give the power factors Mr. ABENDROTH mentions when working on full load, it will generally be found that with the type of motors usually employed in sugar factories, and the necessity of installing ample size machines to take care of the gross overloads so often met with in sugar work, the power factor of the system is more often found to vary between 60 and 80 per cent.

A modern electrically-driven sugar factory, of which the writer has first hand knowledge and recently completely equipped by one of the foremost electrical firms in the United States, has an overall power factor of 76 per cent., while another and older plant, originally steam-driven but now electrified with the exception of the mills, has a power factor as low as 65; and both of these could with profit be corrected.

As touching the methods of power factor correction, Mr. ABENDROTH says he knows of two only, which he describes as Rotary and Static Condensers. These two principles are applied by many methods, but there is yet another which Mr. ABENDROTH did not mention, that of Phase advancing, which can be effected by rotary or vibratory apparatus—this last principle being used largely in Europe, and like the others applied by many different methods.

With regard to the cost of cables, it should hardly be necessary to point out that comparison of cost can only equitably be made at the same load and voltage, so why give direct current the quite arbitrary advantage of operating at 600 volts against an A.C. system at 440? If high voltages are to be used alternating current is eminently adapted to obtain these by the cheap, safe and universal method of step-up transformers or by direct generation. This question of cable cost is indeed a small matter, but if, as Mr. ABENDROTH demonstrates, the cost of A.C. and D.C. systems is about the same, one is permitted to speculate as to why such a trifling matter has ever been brought forward as an additional argument in favour of the D.C. drive.

All enquirers should be grateful for Mr. ABENDROTH's article and the various points he brings up, and it is to be hoped that others will come forward with their views and experiences, so that more light may be thrown on this interesting and important subject. I can heartily endorse Mr. ABENDROTH's remarks concerning the advantages of the electrical drive, and to his list would like to add the decreased cost of running and maintenance charges due to such matters as small quantity of lubricants required, and immunity

from serious breakages due to the closely adjustable protection devices of the electrical control gear, which dissipates in the harmless opening of a circuit breaker any dangerous strains that in steam-driven plants would result in serious damage of the mechanism; and again the prevention of accidents to life and limb by the quick stoppage of the whole or any part of the plant from any point.

In conclusion, it would certainly seem that these preliminary discussions have at least shown that a considerable amount of careful enquiry is needed before a scheme of sugar factory electrification can be evolved, which, in addition to meeting the need of individual mill speed variation, has sufficient good points to enable it to be designated as a standard for this class of work.

The Efficiency of Admixture of Maceration.

By S. S PECK.

In Vol. V of this Journal[1] NOËL DEERR presented an article on "The Coefficient of Admixture of Maceration Water" which included the following statement of the importance of the subject:

> "In the control of the various schemes devised for extracting sugar from the cane by means of the addition of water and known as maceration, imbibition, or saturation, the most important factor is the determination of the degree of admixture of the added water with the residual juice in the megass."

The author then presented two formulae by which this may be measured. In the same volume E. E. HARTMANN suggested a different method of arriving at this figure.[2] In Vol. II, PRINSEN GEERLIGS and E. ROSE[3] gave a formula with the same purpose in view and which was simpler in application.

No one of these formulae has been generally adopted as a routine in mill control. They are applicable only to the consideration of the efficiency of added water and not to that of returned juice or compound maceration. In a long train of mills, even in tandems of four mills, this point is also important, although not to the same extent as obtains in the last mill. The formulae are correct only providing the bagasse per cent cane entering the mill under examination is the same as that leaving it; i.e., the fibre per cent. bagasse must be the same in both instances. The calculations are based on sucrose determinations, but it is well recognised that under conditions of dry crushing tests the sucrose contents of the successive juices drops very decidedly, whereas the density suffers only a small and gradual decrease.

In Vol. XXI of this Journal, an abstract of work done by Dr. R. S. NORRIS on this subject is reported.[4] He determined the Brix of juices coming from the front and discharge rollers of a mill and by their ratio obtaining a measure of the efficiency of admixture of the applied maceration. In a tandem of four mills, the ratio was the highest at the fourth, and lowest at the second mill, due, as explained by the author in his original article (*Planters' Record*, Volume XX) to the increasing density of the maceration juices. The method is simple of application and gives valuable information, but as stated by the author does not give the actual extent of the admixture.

The problem of the economic limit of maceration has been frequently discussed, the opinions of different writers varying very considerably. A general conclusion is that maceration may be carried to the point

[1] *I.S.J.*, 1903, page 35. [2] *Ibid.*, page 177. [3] *I.S.J.*, 1900, page 187. [4] *I.S.J.*. 1919, page 465.

where further additions of water require the use of extra fuel; and this is further complicated by considerations of the rélative values of sugar and fuel. Various ingenious contrivances have been introduced for the purpose of improving the penetration and absorption of added water into the bagasse blanket. The criterion of the success of such apparatus has been the composition of the final bagasse or the figure for extraction. This must of course always be the basis of ultimate judgment, but it would certainly be of interest and probably of value to know to what extent each unit of a tandem is contributing to the final outcome. Dry crushing tests have been introduced as an attempt to ascertain what each unit of a tandem is doing, but are faulty in that they do not represent actual milling conditions. The efficiency of the admixture of the returned juices or added water may be the determining factor in the quality of the work. It is approximately correct to state that the addition of 40 per cent. on cane of water to a mill with a 50 per cent. admixture at this and preceding mills will give about the same extraction figures as the addition of 30 per cent. water with 70 per cent. admixture throughout the train; and in the former case there is 33 per cent. more water to be evaporated than in the latter.

Definition of Degree of Admixture.

A complete admixture of maceration with the residual juice of a bagasse blanket is never achieved in practice. The nearest approach to perfection is obtained where macerating baths are placed between milling units. The percentage of admixture or penetration is a function of the condition of the bagasse, the length of time during which the added maceration is in contact with the bagasse before expression, and the method or conditions of applying the maceration. Under the best of conditions the expressed juice will be found to be of a lower density than the corresponding residual juice. When water is applied to a bagasse blanket there are probably resulting all conditions ranging from over-saturation through normal and down to no water absorption in various strata of the blanket. During travel through the rollers there is a more or less equalizing action, whereby the bagasse issuing is of a fairly constant composition as regards moisture, etc. (There are of course usually irregularities in the blanket due to uneven feed, roller inequalities, etc., which need not be considered in this connexion.) It therefore results that one portion of the bagasse entering the mill is far more saturated than others, and will give up its diluted juice readily. A further portion of the undiluted juice from bagasse not reached by the maceration may be expressed due to heavier mill pressure or differences in mill setting. The total expressed juice is the sum of these and intermediate conditions. There is not necessarily a complete diffusion of the dilutant into the residual juice even in the over-saturated portions.

Admixture is a function of so many different conditions such as quality of preparation of the cane, disintegration of fibre by the rolls, proportion of pith and rind fibre, and time of contact of maceration liquor and bagasse before reaching the expressing rolls, that it is difficult of exact definition. It is suggested that the degree of admixture of applied macèration may be defined as that portion of the added maceration which *theoretically* mixes completely with the residual juice in the bagasse. The balance of the maceration is presumed to join the resulting expressed juice in the juice pans without having come in contact with the bagasse. An example will show that such a definition is applicable to operating conditions. Assume 100 parts of bagasse of 6 per cent. sucrose, 50 per cent. fibre, and 50 per cent. residual juice, this juice

thus containing 12 per cent. sucrose. To this is added 100 parts of water, of which 70 parts admix completely with the juice. The resulting dilute juice then will contain 5 per cent. sucrose; this is also the sucrose per cent. of the residual juice after the bagasse is expressed. If this issues again with 50 per cent. fibre, there will be expressed 70 parts of juice containing at 5 per cent. 3·5 parts of sucrose. This will be diluted in the juice pans with the remaining 30 parts of water, giving a total expressed juice of 3·5 per cent. sucrose. The relation between the sucrose per cent. of this juice and that of the residual juice is as 3·5 to 5·0, or the admixture is, by the PRINSEN GEERLIGS and ROSE formula, 70 per cent. This is the same proportion as of the division of the water assumed. Percentages of Brix could be used instead of sucrose.

If this definition is accepted, and applied to Brix rather than to sucrose, there is possible a fairly accurate method of determining the efficiency of admixture under the varying conditions of milling, applicable to returned juice as well as water maceration, and not influenced by varying composition as regards fibre of bagasse from successive mills.

DEVELOPMENT OF FORMULA.

Assuming a nine-roller mill of three units, with water applied between the second and third mills, and the expressed juice from this mill returned as maceration between the first and second mills, the following determinations are to be made :—

1. Samples of the total juice from the second and third mills analysed for Brix.

2. Samples of bagasse from each mill determined for fibre and Brix of residual juice. In the cases of the second and third mills, these samples must be taken before the succeeding maceration is applied, but must represent bagasse from a mill *before* which maceration has been applied. The Brix of this residual juice is taken as being the same as the Brix of the residual juice entering this mill and also the Brix of the juice expressed at this mill.

3. Fibre per cent. Cane. From this is ascertained the bagasse per cent. cane for each mill by the usual calculation, and from Bagasse per cent Cane minus Fibre per cent. Cane the figure "Juice in Bagasse per cent. Cane" which is used in the formula presented.

Let A, C, and E = Juice in Bagasse per cent. Cane leaving the 1st, 2nd and 3rd mills respectively. Then A and C = Juice in Bagasse per cent. Cane before maceration entering the 2nd and 3rd mills respectively, and E = Juice in Final Bagasse per cent. Cane.

Let B = Difference between Bagasse per cent. Cane entering a mill and Final Bagasse per cent. Cane. In this case it is equivalent to $A - E$.

D = Difference between Bagasse per cent. Cane leaving a mill and Final Bagasse per cent. Cane, or in this instance $C - E$.

R = Brix of Residual Juice entering 2nd Mill, or as determined, the Brix of the residual juice in the 2nd mill bagasse before water is applied.

J = Brix of Total Juice at this mill.

M = Brix of Maceration, which will be the Brix of the total juice at the 3rd mill.

By juice expressed is to be understood that actually expressed from the bagasse reaching the mill with the residual juice of constant composition; that is, with a perfect admixture of a portion of the applied maceration. By total juice is meant this juice plus the excess maceration. R of course will be always greater than J, and J greater than M.

The Efficiency of Admixture of Maceration.

Let W = Water applied per cent. Cane.

Total Juice from 3rd Mill, or Maceration before 2nd Mill $= W + C - E$, or $W + D$.

Total Juice from 2nd Mill $= (W + C - E) + (A - C) = W + A - E$, or $W + B$.

Of the maceration $W + D$, let K parts admix perfectly with the residual juice entering mill, and P parts go to juice pan.

Then : $W + D = K + P$.

Total Juice from 2nd Mill $= W + B = W + B + D - D$; or, from above, $B - D + K + P$, and $B - D + K + P = W + B$.

Juice expressed at 2nd Mill $= A + K - C$. From $C - E = D$, and $A - E = B$ is obtained $A - C = B - D$.

Substituting : Juice expressed at 2nd Mill $= B - D + K$. It follows that :

Expressed Juice + Excess Maceration = Total Juice

$$(B - D + K) + P = W + B$$

Multiplying each by the respective Brix :

$R(B - D + K) + MP = J(W + B)$. And solving for P from $K = W + D - P$:

$P = \dfrac{(R - J)(W + B)}{(R - M)}$ Divide by $(W + D)$, the total maceration applied :

$$\frac{P}{W + D} = \frac{(R - J)(W + B)}{(R - M)(W + D)}$$

As $\dfrac{P}{W + D}$ is the proportion of maceration not absorbed, then

$100 \times \left(1 - \dfrac{P}{(W + D)}\right) = 100 \times \left(1 - \dfrac{(R - J)(W + B)}{(R - M)(W + D)}\right)$ equals Efficiency of Admixture of Applied Maceration.

The only figure not always obtainable is the Water added per cent. cane. Where this water is weighed or measured there is of course the figure W at once available. Where as in most instances this is not done, the figure for the day can be used, calculated in the usual manner ; or the following formula can be taken :

Per 100 cane, Parts Brix entering 3rd Mill = Juice in Bagasse per cent. cane leaving 2nd Mill (C) $\times$ Brix of this Juice (R) or CR.

Per 100 Cane, Parts Brix leaving 3rd Mill = Juice in Final Bagasse per cent. Cane (E) $\times$ Brix of this Juice (R^1), plus Total Juice of 3rd Mill ($C + W - E$) $\times$ Brix of this Juice (M), or $CR = M(C + W - E) + ER^1$, from which :

W (Water per cent. Cane) $= \dfrac{C(R - M) - E(R^1 - M)}{M}$

General Observations.

The formula for admixture applies to any mill, whether the train be of three or more units, providing always that all juice expressed at one mill is used for maceration on a preceding mill, as in usual factory procedure, and all the water added is applied at the mill preceding the last unit.

It applies to the admixture of the water before the last mill, in which case both M and D become zero.

It can be more easily applied on a polarization basis, since the determination of Brix of residual juice in a bagasse is not easy of performance ; but the results will probably be not as accurate as when Brix is the basis.

Finally, it must be impressed that all bagasse samples must represent the product of normal operations of the grinding plant, with all maceration

both of water and juices being normally applied, such operations being stopped when necessary only long enough to withdraw a correct bagasse sample.

EXAMPLE.

An example of an actual test on a nine-roller mill is appended, in which close study will reveal probable faulty conditions of sampling, but which illustrates the application of the formula.

	Crusher Juice.	First Mill.	Second Mill.	Third Mill.
Brix Total Juice	18·20	18·00	5·50	2·10
Polarization Juice	15·80	14·80	4·45	1·48
Bagasse Polarization	11·99	7·51	3·47	1·60
,, Moisture	66·30	48·80	45·00	42·10
,, Fibre	20·75	42·30	50·50	55·70
Calculated :—				
Bagasse, Total Solids (Brix)...	12·95	8·90	4·50	2·20
Brix Residual Juice	16·34	15·43	9·09	4·96
Bagasse per cent. Cane (Cane 12 per cent. Fibre)	57·69	28·37	23·76	21·54

CALCULATION FOR WATER ADDED PER CENT. CANE.

	On Brix.	On Polarization.
R	9·09	7·01
R[1]	4·97	3·61
M	2·10	1·48
C	11·76	11·76
E	9·54	9·54
Water per cent. Cane	26·10	30·21

ADMIXTURE.

	Second Mill.		Third Mill.	
	On Brix.	On Pol'n	On Brix	On Pol'n.
R	9·09	7·01	4·97	3·61
J	5·50	4·45	2·10	1·48
M	2·10	1·48	0·00	0·00
W	26·10	30·20	26·10	30·20
B	6·83	6·83	2·22	2·22
D	2·22	2·22	0·00	0·00
Per cent. Admixture	40·28	47·12	37·34	36·66

Dr. C. CESASOLI, of Arpino, Italy, has patented a process of utilizing molasses as fertilizer by diluting to 32 to 36° Brix and absorbing this solution in kieselguhr or diatomaceous earth. A granular, friable powder, not unlike superphosphate in appearance, is thus obtained. Porous silica obtained as a by-product when leucite is decomposed by hydrochloric acid by the Blanc process, may also be used as an absorbent, in which case the product will contain: 1·1 per cent, of nitrogen, 4·42 of potash, 0·35 of phosphoric acid (as P_2O_5), and more than 20 per cent. of organic matter, which latter is claimed to have more or less the same action as stable manure. This new fertilizer is name "Kaliuzoto," and is being extensively advertised in the Italian agricultural and chemical papers.

EYNON and LANE's method for the volumetric determination of reducing sugars,[1] using methylene blue as internal indicator, after having been tried out at the H.S.P.A. Experiment Station on juices. is pronounced as giving results which are more consistent than generally are found by gravimetric methods, besides demanding much less time. But some preparations sold as methylene blue are unsatisfactory, and Schultz No. 659 is considered a satisfactory shade for use for the purpose. When excessive frothing occurs, it interferes with the end-point, increasing therefore the danger of back-oxidation, but this may be prevented by rubbing a very small quantity of vaseline inside the neck of the flask, this melting, and running down into the boiling liquid during titration.

[1] *I.S.J.*, 1923, 143, 305; 1924, 107; 1925, 332; *Hawaiian Sugar Planters' Record*, 1926, 30, 461-465.

Revised Sugar Duties of Japan.

(A) Customs Duty.

Articles.	General Tariff. (Units)	Former Rates of Duty. yen.	New Rates. yen.
Sugar :			
1. Under No. 11 D.S.	100 kin	2·50	2·50
2. „ No. 15 „	„	3·10	3·95 up to No 22 Dutch Standard.
3. „ No. 18 „	„	3·35	
4. „ No. 21 „	„	4·25	
5. Other	„	4·65	5·30
Rock candy sugar, cube sugar, loaf sugar, and similar sugar	„	7·40	7·40
Molasses :			
1. Containing not more than 60 per cent by weight of sugar calculated as cane sugar	„	1·30	1·30
2. Other	„	2·50	2·50
Grape sugar, malt sugar and "Ame"	„	13·65	13·65
Honey	„ including receptacles	7·20	7·20
Confectioneries and cakes	„	32·00	32·00
Jams, fruit jellies, and the like	„	17·50	17·50
Biscuits (not sugared)	„	13·30	13·30
Macaroni, vermicelli, and the like	„	7·90	7·90
Fruit-juices and syrups :			
1. Fruit-juices (sugared) and syrups			
A. In bottle or tin	„ including receptacles	15·30	
B. Other	„	10·70	10·70
2. Other	„ including receptacles	11·00	11·00

(B) Consumption Tax.

Sugar, molasses and syrups taken delivery of from the factories, Custom-houses or bonded warehouse, for the purpose of being consumed in the Empire, the following consumption tax shall be imposed :—

	(Units).	Former Rates of Tax. yen.	New Rates. yen.
1. Sugar :			
Class I. Sugar under No. 11 D.S. :			
A. Black sugar in cask	100 kin	2·00	1·00
B. Shiroshitato in cask	„	2·50	2·00
C. Other	„	3·00	2·50
Class II. Sugar under No. 15 D.S.	„	5·00	5·00
„ III. „ No. 18 „	„	7·00	
„ IV. „ No. 21 „	„	8·00	7·35 (under No. 22)
„ V. Sugar at or above No. 21 D.S.	„	9·00	8·35 (above No. 22)
„ VI. Rock candy sugar, cube sugar, loaf sugar, and similar sugar	„	10·00	10·00
2. Molasses :			
Class I. Molasses produced in making rock candy sugar :			
A. Containing not more than 70 per cent. by weight of sugar calculated as cane sugar	„	3·00	3·00
B. Other		Reckoning at the ratio of yen 9·00 per 100 kin of sugar contained, calculated as cane sugar.	Reckoning at the ratio of yen 8·35 per 100 kin of sugar contained, calculated as cane sugar.
Class II. Other molasses :			
A. Containing not more than 60 per cent. by weight of sugar calculated as cane sugar	100 kin	2·00	1·00
B. Other	„	3·00	2·50
3. Syrups	„	3·00	7·35

Examination of Boneblack.[1]

By H. I. KNOWLES.

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Only the three essential requirements of boneblack—colour adsorption, ash removal, and hardness, or resistance to mechanical disintegration during service—will be considered here.

Raw Material.

The quality of boneblack is related to the kind of bones used in its manufacture. Some authorities believe that beef bones make the best char, but not all the bones of an animal are of equal value. It is possible that some bones of other animals produce better boneblack than certain beef bones. For instance, boneblack made from hard tissue, like shanks or marrows, is generally superior to that derived from bones of a more delicate structure, such as knuckles.

Shank and Knuckle Boneblack.—Bones[2] burned in a regular bone kiln were passed through a laboratory jaw crusher, sieved and the fraction passing 14-mesh and remaining on 35-mesh taken for examination. Screen analysis of the boneblack gave the results shown in Table I. Colour and ash removal was tested by the following method : Wash the char on a filter with 35 times its weight of water at 77°C. (170°F.) and dry. Mix a quantity of char (the same quantity in each test) in a glass flask with a 50° Brix solution of a molasses sugar equal to twice the weight of char ; heat the mixture during 3 hours at 77°C. (170°F.), shaking the flasks gently for 30 seconds every half-hour ; and filter the solution through paper. Also heat and filter a blank sugar solution. Refilter all filtrates until sufficiently clear for spectrophotometric colour analysis and determine the ash content of the same solution by the sulphated method. This procedure was used in other colour and ash removal tests herein reported. Table II gives the results of the chemical analysis ; and Table III shows the colour and ash absorption powers of the boneblack.

Table I.—Grist Analysis of Shank and Knuckle Boneblack.

Mesh	Shank Per Cent.	Knuckle Per Cent.
On 16	10·5	0·8
On 24	30·6	28·5
On 30	42·9	49·4
On 35	14·7	19·3
On 50	0·9	1·5
Through 50	0·3	0·3

Table II.—Composition of Shank and Knuckle Char.

Determination	Shank Char Per Cent.	Knuckle Char Per Cent.
Carbon	7·260	16·37
Insoluble in HCl	0·120	0·96
Calcium carbonate	9·490	7·48
Apparent specific gravity	0·662	0·502

Table III.—Colour and Ash Removed by Shank and Knuckle Char.

Solution	Colour Units in Blank	Colour Removed: Shank Per Cent.	Colour Removed: Knuckle Per Cent.	Ash in Blank Per Cent.	Ash Removed: Shank Per Cent.	Ash Removed: Knuckle Per Cent.
1	1880	93·3	97·2	1·250	56·1	54·4
2	1000	96·9	98·4	0·723	64·1	60·0
3	528	97·3	98·1	0·331	68·5	62·5

1 Condensed from a paper presented before the Division of Sugar Chemistry at the 72nd Meeting of the American Chemical Society, Philadelphia, Pa., 1926.

2 Supplied through the courtesy of J. A. B. Ball of the St. Lawrence Sugar Refining Company.

Examination of Boneblack.

Owing to the greater decolorizing power of the knuckle char, it might be inferred that it is the better black. Boneblack in service, however, is seldom called upon to filter sugar solutions of colour much over 1000 units and the greater proportion of sugar liquor has a colour of less than 500 units. In practice, therefore, the shank char would probably be found as good a decolorant as the knuckle black and in addition it would remove more inorganic matter.

DECOLORIZATION.

It is generally recognised that decolorization is an adsorption phenomenon. This, in conjunction with what is known about the active and inactive forms of carbon, explains much of the decolorization differences of various chars. It also shows that the carbon in boneblack must be considered with respect to quality, quantity, and distribution.

Reference to the carbon content and colour adsorption of shank and knuckle chars shows that the carbon content is not always a criterion of char value, and that there is a difference in carbon quality. Presumably the treatment bones receive prior to conversion to boneblack influences this. That the activity of the carbon of service chars apparently is not always the same is shown by a comparison of the carbon obtained from three service chars (*A*, *B* and *C*). *A* is the oldest and poorest; *C* is the newest. In addition to washed sugar liquor, *A* is called upon to filter such liquors as char water and affination syrup. With the exception of washed sugar liquor, *B* and *C* filter only char-filtered liquors. Table IV shows the carbon content of the three chars and the colour adsorbed by the derived carbon.

TABLE IV.—DECOLORIZATION BY CARBON OF BONEBLACK.

Boneblack	Carbon Content Per Cent.	Colour Adsorbed by Carbon Per Cent.
A	15·73	73·8
B	6·81	85·8
C	7·69	86·0
A (decarbonized)	9·55	72·5
	6·00	72·6

As adsorption is a surface phenomenon, it is conceivable that there is an optimum carbon content of boneblack depending upon the available bone surface area. This would correspond to a carbon layer of some definite thickness. A deeper layer would tend to cover underlying carbon and reduce the pore area, thus decreasing adsorption. Less carbon would reduce the carbon surface area with the same result. If this be true, what is the optimum carbon content of boneblack? We may seek an answer by examining the results of some decarbonization and recarbonization experiments conducted with service chars. Table V shows the results of colour and ash adsorption tests made on *A* char decarbonized and *B* char successively recarbonized with bone oil.

The results in Table V are suggestive rather than conclusive. In both chars the optimum carbon content appears to be about 6 per cent. The increase in ash removal of *A* is attributable to the increase in porosity of the char. In *B* the small differences are probably due to incomplete removal of bone oil during heating. During the same period boneblack which in service accumulated carbon showed the changes given in Table VI. *B* was being gradually replaced by char of about 10 per cent. carbon content and *A* was replaced by *B* char—i.e., by char of about the same carbon content. The peak of decarbonization was reached after 15 months, when the carbon content had become about 7 per cent., the decolorizing power then beginning to decline.

After five months it was back again to a value corresponding to a carbon content of about 3·75 per cent. Other factors influence the activity of service char, but during the period under consideration conditions were much the same. It is likely, therefore, that the activity noted is in large measure the result of carbon changes in the char. As the ash removal has also decreased, it would appear that the reduction of porosity by carbon accumulation was responsible.

TABLE V.—COLOUR AND ASH REMOVAL BY DECARBONIZED AND RECARBONIZED BONEBLACK

Carbon Per Cent.	Colour Removed Per cent.	Ash Removed Per Cent.
A (decarbonized char)		
15·73	53·2	14·5
13·97	53·8	28·7
9·25	64·7	36·3
5·96	74·5	42·1
5·34	70·5	—
B (char recarbonized with bone oil)		
3·47	66·7	29·6
4·52	75·6	35·6
5·71	77·0	32·1

With regard to new boneblack, the optimum carbon content obviously is the maximum consistent with maximum ash removal and hardness. Taking shank char as a standard, the optimum would appear to be between 9 and 10 per cent. carbon. New boneblack with a carbon content much lower than 9 per cent. would probably be deficient in decolorizing power. A new char having more than 10 per cent. carbon would probably remove less ash and be more susceptible to shrinkage during service.

ASH REMOVAL.

Removal of inorganic matter from sugar solutions by boneblack is generally attributed to the inorganic constituents of the char, principally the bone itself. Investigators have found that the action is selective. Not having the results of these investigations available, the writer conducted some experiments to show this selective action.

To several portions of a 60° Brix granulated sugar solution were added various salts in quantities approximating 0·5 per cent. of the sugar solids. The solutions were digested for three hours at 82°C. (180°F.) with a quantity of boneblack equivalent to 100 per cent. of the sugar solids present. Filtration through paper followed, and the ash was determined by the sulphated method, but the customary correction of — 0·1 has not been applied. In some cases an analysis was made to show the selective removal of ions.

The results in Table VII support the generally accepted views regarding the removal of salts by char. The action of char in this respect is complicated by the exchanging of some of the base. Thus, a qualitative analysis of solutions showing an increase in ash demonstrated that lime, presumably derived from the calcium carbonate of the char, had gone into solution.

TABLE VI.—CHANGE IN BONEBLACK DURING SERVICE.

	Carbon			Colour Adsorbed			Ash Removed		
CHAR	Initial Per Cent.	After 15 months Per Cent.	After 20 months Per Cent.	Initial Per Cent.	After 15 months Per Cent.	After 20 months Per Cent.	Initial Per Cent.	After 15 months Per Cent.	After 20 m's Per Cent.
A	3·76	7·02	8·00	73·2	82·0	74·0	38	39	35
B	3·85	7·59	7·90	87·4	90·3	87·8	48	55	50

This was particularly true of the ferric chloride solution, from which iron was almost completely removed. In the magnesium nitrate solution, less magnesia was present after char filtration. The increase noted for the potassium chloride solution can be accounted for to a large extent by the increase in ash of the blank solution. Of particular interest is the removal by char of calcium acid phosphate and the phosphate ion. Similar treatment of sugar solutions containing iron tannate and iron pyrogallate, in quantities equivalent to 0·012 and 0·011 per cent. Fe_2O_3 respectively, removed the pyrogallate completely, but not the tannate. Removal of the tannate was nearly complete, however.

TABLE VII.—REMOVAL OF SALTS AND IONS BY BONE BLACK.

Salt	Sulphated Ash Initial Per Cent.	Sulphated Ash Removed Per Cent.	*pH* of Solution Initial	*pH* of Solution Final	Ion	Ions Initial Per Cent.	Ions Removed Per Cent.
KCl	0·326	2·5†	6·60	7·3	Cl	0·1340	2·1
K_2SO_4	0·276	26·8	6·60	8·3	SO_4	0·1480	45·5
$NaC_2H_3O_2$	0·155	29·7	6·90	7·6	—	—	—
$K_2C_2O_4$	0·283	41·4	6·80	8·5	—	—	—
$CaCl_2$	0·301	7·7	6·70	6·9	Ca	0·0884	12·0
					Cl	0·1550	6·5
$CaSO_4$*	0·286	68·2	6·90	6·8	Ca	0·0738	63·7
					SO_4	0·0277	46·2
$Mg(NO_3)_2$	0·013	13·6†	6·60	6·9	—	—	—
$FeSO_4$	0·013	72·0	5·00	6·5	—	—	—
$FeCl_3$	0·170	31·8†	6·15	5·9	—	—	—
NaH_2PO_4	0·234	60·2	6·15	7·1	PO_4	0·2190	99·3
$CaH_4(PO_4)_2$	0·286	95·0	‡	‡	PO_4	0·3900	98·7
Blank	0·00577	154·5†	6·60	7·2	—	—	—

The extent to which the different ions are removed is suggestive of adsorption. This, in conjunction with the fact that ash removal by boneblack depends upon ash concentration, indicates that ash removal is an adsorption phenomenon. If then colour and ash removal by boneblack are the result of adsorption, it follows that any test devised to measure colour and ash adsorption must take into account colour and ash concentration. In addition, Brix is an influence of no small importance. The relation between colour and ash removal, Brix and the quantity of char is shown in the accompanying diagram. The apparent amount of colouring matter in a sugar solution is influenced also by the *pH* of the solution. The influence of the several factors considered demonstrates the necessity of conducting colour and ash removal tests under carefully standardized conditions.

HARDNESS.

Presumably the real hardness of various kinds of bone is much the same. As applied to boneblack the term hardness possibly refers to the structural strength of the particles of bone. Thus a very porous bone of honeycomb structure would not be expected to resist impact as well as a more solid bone. The shape of the bone particle would also be a factor. Spindle-shaped particles would tend to break up more readily than round particles. Any test for hardness, therefore, should recognize, and distinguish between, the various factors which determine to what extent a boneblack might be expected to resist impact and attrition during service.

* Calcium saccharate and sulphuric acid were added to a granulated sugar solution and the precipitated calcium sulphate was filtered off. Evidently the solution contained calcium oxide in excess of the SO_4 equivalent.

† Per Cent. increase. ‡ Less than 3·1.

A number of years ago, HORNE devised a test for hardness by rotating boneblack in a tin can with marbles and measuring the increase in fines. The writer has elaborated this test by using a cast-iron ball mill, of the turnip type and 1¼ lbs. dry capacity, and 10 steel ball-bearing balls, 9 in. in diam. When rotated at about 20 r.p.m., the char and balls run together down the side of the mill in a position at about 45 degrees to the horizontal.

In developing this hardness test, it was early recognised that to get an adequate expression of hardness, char subjected to test must be gristed within rather narrow limits. The grist 16 × 24 was chosen, in the belief that it would include the larger portion of either a 16 × 30 or a 10 × 28 boneblack. For purposes of test, the sample of boneblack is therefore sieved to obtain the 16 × 24 fraction. One hundred grams of this fraction are sieved on 24-mesh and 50-mesh sieves for 10 mins., using a mechanical sieve shaker. The portions passing the 24-mesh and 50-mesh sieves are weighed. The three fractions are reunited and put in the ball mill with the steel balls. After rotating the mill for 15 mins., or for 450 revs., should the speed be somewhat different than 30 r.p.m., the char is removed and resieved. The total net loss on 24-mesh has been termed the "shrinkage number," and the net gain through 50-mesh has been designated as the "discard number," it being assumed that in practice char finer than 50-mesh would be removed by screening. Duplicate tests give results that seldom vary more than 0·5 for the shrinkage number and 0·2 for the discard number. Some results are given in Table VIII.

TABLE VIII.—RESULTS OF HARDNESS TEST ON CHAR.

Char	Shrinkage No.		Discard No.	Remarks
Shank	11·9	..	2·4	Used 30 per cent. 14 × 16 mesh
Knuckle	17·7	..	2·4	Used 70 per cent. 16 × 24 mesh
New	12·2	..	2·1	Good char
New	16·5	..	3·1	Poor char
Service *A*	5·2	..	0·5	Oldest
Service *B*	9·4	..	1·5	—
Service *C*	10·9	..	1·9	Newest

Experience with this test is limited. From the results so far obtained, however, it expresses satisfactorily differences in the quality of boneblack and hardness as judged by colour and ash adsorption tests, specific gravity, and resistance to crushing between the fingers. Thus, a good char will show a shrinkage number of 12 to 13 and a discard number of 2 and 2·5. Poorer blacks give corresponding numbers of 14 to 17 and 3 to 3·5. The values for service chars show that new char is soon reduced to a shrinkage number of about 10, and a discard number of about 2 and that during service the softer friable particles are discarded. There is suggested also the possibility of using the test to determine undue shrinkage as the result of faulty handling of the black during service.

At a meeting of the Jamaica Imperial Association held in Kingston recently, Mr. HAROLD POOLEY, General Secretary of the British Empire Producers' Organization. summed up his views on the economic future of the West Indies in these words: "The only hope of the West Indian Colonies now for, not only prosperity, but their very existence, lies in their taking their full part in the Empire economic movement, to which their history and traditions entitle them." He had been particularly struck by the inadequate system of accounting on sugar estates, which prevented a proper control being kept of the cost of production. There was no doubt that the direction in which the sugar industry most needed supervision was in the cost of field production.

Some Interesting Sugar-house Incrustations.[1]

By JOHN W. SCHLEGEL and J. P. MANLEY.

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Char filter deposit.—Several years ago it was noticed that in the filtration of high remelt syrups over boneblack a heavy, sticky sludge ultimately formed upon the upper surfaces of the filters, retarding the flow of liquor through the filters and later affecting the efficiency of the sweetening-off process. Investigation showed that, although the high remelt syrups from the centrifugal machines were brilliant, a flocculent precipitate appeared upon later dilution and heating, preparatory to char filtration. This precipitate was later found deposited upon the upper surfaces of the char filters. A portion of this smear from the char filter tops was washed free from sugar, dried, and analysed, with the following results :—

	Per Cent.		Per Cent.
Organic and volatile	37·60	P_2O_5	1·41
SiO_2	44·05	CaO	4·65
SO_3	5·48	MgO	2·82
$Fe_2O_3 + Al_2O_3$	3·99		
		TOTAL	100·00

This scale evidently consists mainly of silica, combined with calcium sulphate, iron and alumina, and probably basic magnesium silicate. The very interesting feature of this deposit is its high percentage of silica, due probably to the use of diatomaceous earth in the clarification of the washed sugar liquors. During such clarification, especially if an excess of lime is used, small quantities of silica are dissolved from the earth, the degree of solubility depending largely upon the excess of lime used. Although normally, only mere traces of silica are dissolved, sometimes so much may be taken up that upon the subsequent concentration of the impurities in the lower grade syrups, their limit of solubility is reached and the silica separates out. This is what seems to have happened in this case, for with more careful control over the defecation the deposition ceased.

Liquor pipe incrustations.—Scales found in the outlet pipes from low-grade char filters, used for the filtration of raw sugar washings through boneblack, were analysed, one lot about six years later than the other. These scales ultimately practically closed up the pipes. The composition of the scale was as follows, all analyses being made upon the washed and dried scales :—

	Scale No. 1. Per Cent.	Scale No. 2. Per Cent.
Volatile and organic	26·30	30·27
SiO_2	49·66	48·02
CaO	3·60	7·00
Fe_2O_3	3·20	1·02
Al_2O_3	9·95	2·42
SO_3	1·80	2·19
MgO	0·35	0·42
P_2O_5	0·53	3·05
CuO	Small amount	Small amount
Undetermined	4·61	5·61
TOTAL	100·00	100·00

Here again the high percentages of silica are the significant feature, the quantities of bases present being too small to account for the total amount of this constituent.

Kiln flue deposits.—On repairing a chimney which had been in use for twenty years, the interior was found heavily incrusted with scale, the colour

[1] Condensed from a paper presented before the Division of Sugar Chemistry at the 72nd Meeting of the American Chemical Society, Philadelphia, Pa., 1926. *Ind. Eng. Chem.*, 1927, 19, 219-221.

of which was a peculiar mixture of white, yellow, and brown, partly amorphous partly crystalline. The crystalline portion consisted mainly of well-formed clusters of radiating needles, distinctly visible upon even macroscopic examination. This scale was contaminated with ash dust from the coal fires of the kilns. The total air-dried scale consisted of 68·06 per cent. water-soluble and 31·94 per cent. water-insoluble matter. The water-soluble fraction contained 80·26 per cent. organic and volatile matter and 19·74 per cent. mineral matter. The water-insoluble fraction contained 17·25 per cent. organic and volatile matter and 82·75 per cent. mineral matter. That is, the total scale contained 60·13 per cent. volatile and organic matter and 39·87 per cent. mineral matter. A complete analysis of the water-soluble portion gave the following results :—

	Per Cent.		Per Cent.
$(NH_4)_2O$*	32·14	K_2O	0·25
SO_3	51·76	Na_2O	0·62
Cl	4·86		
Fe_2O_3 } Al_2O_3 }	0·73	Total	100·58
		O in excess of Cl	2·19
CaO	8·17		
MgO	0·24		98·39
P_2O_5	1·81	Undetermined	1·62
		Total	100·00

* 17·29 per cent N.

As the non-volatile portion of the water-soluble part contained 8·27 per cent. of SO_3, it is evident that this scale consists mainly of ammonium sulphate and calcium sulphate, with probably some potassium or sodium sulphate, and small quantities of the chlorides of these bases.

Char dryer incrustation.—In the burning of boneblack in the ordinary vertical retort kiln, the hot gases from the fuel bed (in this case coal) are passed through the horizontal pipes of a super-imposed dryer, the wet black being partially dried before entering the retort pipes by passing through this dryer. A yellow scale found adhering in the form of incrusted nodules to the inside of dryer pipes which had been in use for about twenty-five years was scraped off and analysed with the following results :—

	Per Cent.		Per Cent.
SiO_2	3·04	$(NH_4)_2O$	5·38
CaO	0·68	H_2O (combined)	10·21
Fe_2O_3	46·02	Undetermined	2·75
P_2O_5	0·80		
SO_3	31·12	TOTAL	100·00

Investigation showed the SiO_2 to be present as such, the $(NH_4)_2O$ as $(NH_4)_2SO_4$, and the CaO as $Ca_3(PO_4)_2$. This left the Fe present as a combination of Fe_2O_3 (46·02 per cent.), H_2O (10·21 per cent.), and SO_3 (22·89 per cent.), which corresponds to a formula, $FeSO_4(OH)_4$. This formula corresponds to that of the insoluble salt produced from certain iron mordants as described by ROSCOE and SCHORLEMMER,[1] except that the water of crystallization does not seem to be present. This is probably due to the fact that this scale was subjected to a considerable and continuous heat during its formation. This scale may therefore be said to have the following composition :—

	Per Cent.		Per Cent.
SiO_2	3·04	$FeSO_4(OH)_4$	79·07
$(NH_4)_2SO_4$	13·66	Undetermined	2·75
$Ca_3(PO_4)_2$	1·48		
		TOTAL	100·00

[1] "Treatise on Chemistry," Vol. II., p. 1239.

Heater incrustation.—In order to extract as much heat as possible from them, waste waters from char filters are passed through so-called "Miles" heaters, consisting of two horizontal headers in which are expanded vertical copper tubes. The hot waste waters are passed through these copper tubes, and incoming cold fresh water is passed around the outside. After several years of use, the inside of these copper tubes are usually incrusted with a black slimy deposit, ordinarily organic, and readily removable by hot caustic soda solution. A heavy black incrustation of the copper tubes removed from one of these heaters in this refinery proved to be insoluble in caustic soda solution. This scale was arranged in strata, varying in colour from a blue-black to a jet black, and when dried had the following composition :—

	Per Cent.		Per Cent.
CuS	55·38	$Fe_2O_3 + Al_2O_3$	1·51
CuO	39·94	CaO	0·27
$CuSO_4$	0·52		
SiO_2	1·39	TOTAL	99·01

The formation of this very unusual scale can probably be ascribed to the frequent presence of hydrogen sulphide or other sulphurous compounds in the char waste-waters, these being particularly noticeable by the odour of the waste-water after it has been allowed to remain in the char filter or other receptacle. The insoluble cupric sulphide would of course be readily formed by the direct action of the sulphurous waste water upon the copper tubes. The formation of the cupric oxide can probably be best explained by the interaction of the ammoniacal bodies always present in waste-water with either the cupric sulphide or the copper tubes, or by the interaction of the caustic soda with which these tubes had been boiled several times with the cupric sulphide. This black scale contained no organic matter.

Press plate scrapings.—The ordinary plate-and-frame filter-press seems to be peculiarly susceptible to the deposition of scale upon the corrugations and faces of the plates. At times this scale becomes so heavy as to necessitate its removal with sharp scraping tools. Dense scales from two presses of this kind, which had been used for several years for the filtration of phosphate sludge from the refinery bag-filters, were removed by scraping, freed from all fibres and magnetic material, dried and analysed. Scale No. 1 was obtained in 1919 and Scale No. 2 about two years later.

	Scale No. 1 Per Cent.	Scale No. 2 Per Cent.		Scale No. 1 Per Cent.	Scale No. 2 Per Cent.
Organic matter	29·99	30·46	P_2O_5	7·25	3·81
CaO	21·33	22·45	MgO	6·48	5·84
$Fe_2O_3 + Al_2O_3$	12·41	14·16	CO_2	6·50	7·92
SiO_2	14·89	13·37	SO_3	0·91	1·64
			TOTAL	99·76	99·65

Boiler incrustation.—Yellowish brown stalactitic deposits around the caps of water-tube boilers, caused by leakage from within the boiler, were examined. Investigation showed that traces of waste-water from the char filters had leaked into the boilers where, through interaction with the soda ash present, it formed the deposit. Analysis of this stalactitic scale gave the following results :——

	Per Cent.		Per Cent.
H_2O (hygroscopic) (110°C.)	5·25	Na_2O	3·61
H_2O (combined) (300°C.)	8·44	Na_2SiO_3	0·67
Na_2CO_3	21·19	K_2SO_4	9·73
Na_2SO_4	15·21	$MgSiO_3$	0·92
NaCl	5·80	Volatile organic matter	11·30
Na_2CO_3	17·34		
		TOTAL	99·46

Water purifier incrustations.—In the purification of boiler feed waters containing rather large quantities of calcium and magnesium carbonates, by the use of a mixture of soda ash and caustic soda, the following procedure was adopted. The water was mixed continuously with the mixed purifying reagents, and immediately passed through Hoppes water-purifiers, comprising a series of horizontal superimposed shallow trays, the water entering at the top and flowing from tray to tray, leaving at the bottom on its way to the boilers. The function of the trays is to hold back as much of the precipitated sludge as possible. It was found that the water leaving these purifiers, although ordinarily clear, was distinctly turbid at the time these samples were taken. This separated material was found to consist almost entirely of a basic magnesium silicate. Complete analyses of the scales found in the Hoppes water purifier were made. The pans in the water purifier, opened for this purpose, were heavily loaded with precipitated sludge, deposited at both top and bottom. As the bottom sludge had a somewhat different appearance from the top sludge, samples of both were taken from each row of pans. Analyses of these scales are shown in the table following.

Nature of Incrustation	Pan No. 1 Top	Pan No. 1 Bottom	Pan No. 3 Top	Pan No. 3 Bottom	Pan No. 5 Top	Pan No. 5 Bottom
SiO_2	2·44	5·70	6·91	18·32	14·10	23·63
Organic	0·25	0·31	0·13	0·65	0·59	1·29
$Fe_2O_3 + Al_2O_3$	0·56	0·16	0·48	0·19	0·35	—
CaO	52·39	50·16	46·35	30·69	33·51	5·87
MgO	3·17	7·14	8·77	20·64	18·57	40·47
SO_3	0·00	0·00	0·07	0·29	0·20	0·47
CO_2	39·59	34·89	33·54	22·82	26·26	8·57
H_2O (combined)	1·60	3·63	4·56	7·22	7·39	15·70
P_2O_5	0·00	0·00	0·00	0·00	0·00	4·34
TOTAL	100·00	101·99	100·81	100·82	100·97	100·34

Nature of Incrustation	Pan No. 7 Top	Pan No. 7 Bottom	Pan No. 8 Top	Pan No. 8 Bottom	Pan No. 9 Top	Pan No. 9 Bottom
SiO_2	21·41	33·17	25·95	36·09	23·64	37·39
Organic	0·98	2·08	2·67	3·51	2·72	3·68
$Fe_2O_3 + Al_2O_3$	—	—	0·78	0·32	0·40	0·51
CaO	11·87	1·83	11·45	1·34	20·00	0·97
MgO	30·44	44·87	37·37	43·57	29·67	43·20
SO_3	0·47	0·40	0·48	0·38	0·42	0·32
CO_2	14·60	3·23	10·19	2·59	14·82	1·93
H_2O (combined)	11·58	14·89	12·07	13·17	9·44	13·04
P_2O_5	9·41	1·14	0·00	0·00	0·00	0·00
TOTAL	100·76	101·61	100·96	100·97	101·11	101·04

These results explain the reactions taking place in the purification of the boiler feed water. The lime compounds were readily separated and deposited from the water, as shown by the decrease of the CaO and CO_2 from the top to the bottom of the purifier. The percentages of MgO, SiO_2, and combined water increase from the top to the bottom. Obviously then the cause of our trouble was the slow precipitation and separation of the magnesia in the form of basic magnesium silicate, a separation so slow as to be incomplete when the water left the purifier. The percentages of CaO and CO_2 are consistently higher, and those of MgO, SiO_2, and combined water are consistently lower in the top scale than in the bottom scale. This difference in composition is probably due to the fact that the water splashes into the tops of the trays, while the bottom scales are deposited from water overflowing from the top and running down along the bottom of the trays to the next row. The separa-

tion of the basic magnesium silicate does not seem to be a function of time only, but also seems to be very susceptible to slight changes in operating conditions.

Steam trap sludge.—A return trap used for a long time to separate the condensate from our steam lines was found on being opened to be almost full of a heavy oily deposit. A portion of this deposit was extracted until free from oil and the residue dried. The oil-free sludge had the following composition :—

	Per Cent.		Per Cent.
Moisture	1·47	Al_2O_3	1·19
Organic matter, H_2O (combined), CO_2	20·82	Cu	Trace
		Zn	Trace
		SiO_2	23·42
MgO	24·77	SO_3	0·86
Fe_2O_3	12·14	P_2O_5	0·55
CaO	7·92	Cl	0·35
Na_2O	4·42		
K_2O	1·91	TOTAL	99·82

This sludge therefore consists mainly of oil, basic silicate of magnesium, and iron rust. The basic silicate of magnesia was undoubtedly carried over by entrainment from the boilers and deposited in the trap.

Overseas Trade Reports.[1]

BELGIUM.

According to the Report on the economic situation in Belgium during 1926, as prepared by H.M. Embassy at Brussels, the number of sugar factories working in Belgium in 1926 was 54, as compared with 58 in 1925. It is estimated that sugar production for the 1926-27 campaign will not amount to more than 240,000 tons, as compared with 350,000 tons in 1925 and 400,000 tons in 1924. Among the various reasons for this decrease may be cited the reduction in the area sown, which was 18 per cent. lower than in 1925, and the lower proportion of sugar contents in this season's crop, the deficiency being approximately one degree. As the quantity of sugar used by the Belgian population continues to increase and is now almost 27 kilos. per inhabitant, as compared with 12 kilos. prior to the war, the quantity available for export is likely to be much smaller than usual. The improved value of the French franc in the course of the sugar campaign brought about the purchase of large quantities of Belgian sugar beet for export to France, so that the Belgian factories were threatened with a shortage of supplies. The Government, however subjected the export of sugar beet to licence as from November 7th.[1]

Price of sugar on the home market during 1926 have varied considerably with the rate of exchange, and from 150 francs per 100 kilos. in January the market quotation rose to 340 francs in July, to fall to 250 francs in September. It was 316 francs. in December. Stocks on hand in November amounted to 118,677 tons, including 5557 tons of foreign sugar.

The decline of the Belgian sugar industry is having the attention of the Government and measures to remedy the situation are being considered. The diminished export trade is said to be due not only to increased tariffs and greater competition abroad, but also to the system of export bounties which has recently been re-established in certain countries.

The following table shows the production and consumption of sugar during the years 1925 and 1926 :—

	1925. Tons.	1926. Tons.
Raw Sugar	348,615	210,752
Refined Sugar	174,274	174,982
Consumption	158,000*	—

[1] Abrogated by Royal Decree of December 30th.
* Does not include quantities used for industrial purposes.

Imports of raw cane sugar (37,000 tons) showed a decrease as compared with the first nine months of 1925 (49,000 tons). The chief sources of supply were Cuba (17,000 tons), Peru (10,000), Dutch Guiana (5000) and the Dominican Republic (3600).

The exports of refined powdered sugar amounting to 73,000 tons, as compared with 92,000 tons for the first nine months of 1925 also show a decrease of 19,000 tons. Exports to Great Britain, formerly one of the largest markets, have fallen to 13,000 tons, as compared with 30,000 in 1925. Other important markets were Holland (13,000 tons), France (13,000 tons), British India (11,000), Switzerland (9000), Egypt, Morocco, Tunisia, Germany and Canada. The total exports of all kinds of refined sugar (including lump, powdered, crystallized and candied sugar) amounted for the nine months ending September 30th to 107,000 tons. Exports of raw beet sugar amounted to only 3000 tons, as compared with 24,000 tons for the corresponding period in 1925.

PERU.

The sugar cane has been cultivated in Peru since early Spanish colonial times, but the modern sugar industry dates back only about 50 years. It is now one of the most important Peruvian crops, and it is estimated that there are about £p12,500,000 invested in the industry. The principal centre of production is in the Chicama valley near Trujillo, where the industry is controlled by five large estates, employing the most modern methods and equipment; also around Pativilca, Chiclayo, Supe, Huacho and Lima, and in the Tambo valley, near Mollendo. There are 31 sugar mills in Peru, of which about 10 are thoroughly up to date, employing the latest British and North American machinery. Sugar cultivation in Peru received its great impetus during the war, but it has suffered a serious decline during the last three years owing to low prices consequent upon world over-production. Many planters have become discouraged and have turned their fields over to cotton, which seems to promise larger returns, but the majority are searching for ways and means to increase the sugar yield, and also to cut down the loss from disease and parasites, which are said to destroy no less than 20 per cent. of the total crop. Prices of sugar in 1923 were very encouraging, averaging 20s. per quintal; in 1924 they fell to 13s. per quintal, while in 1925 the average price was only 9s. 6d. per quintal, which is far below the cost of production. Prices in 1926 were still depressed, but in September the situation became a little more hopeful with a rise in the market to 11s. 3d. per quintal, and prospects for further improvements in sight.

The following are the principal statistics regarding sugar cultivation, production and export during the last three years :—

	Area under Cultivation. Acres	Production. Tons.	Exports. Quantity. Tons.	Exports. Value. £p
1923....	133,977	315,277	282,493	6,266,209
1924....	143,943	319,544	265,509	4,976,430
1925....	134,000	269,760	208,140	2,158,651

There are no sugar refineries in Peru, all sugar being exported in the raw state for subsequent refinement in the principal centres of consumption. About 15 per cent. of the total sugar production is consumed in the country. The bulk of the export is divided between Chile and Great Britain, with the United States also figuring as a minor customer.

About 4 million litres of pure alcohol are distilled annually from sugar cane in Peru, all of which is consumed locally for domestic purposes. It is estimated that about 20 million litres of alcohol could be produced annually if a profitable market could be found for it.

BRAZIL.

The Brazilian sugar industry has been in a critical condition in recent years, and the low prices prevailing in the European and American markets have had an extremely adverse effect in Brazil.

[1] From Consular Reports of the Department of Overseas Trade, London.

Exportation, which attained considerable proportions during the war and in subsequent years, has dwindled to an insignificant quantity :—

	Total Production. Tons.	Exports. Tons.	Value. £.
1921	646,000	172,000	3,292,000
1922	926,000	252,000	3,323,000
1923	761,000	153,000	3,171,000
1924	812,000	34,000	769,000
1925	831,000	3,000	55,000

High prices, with considerable oscillations, have been maintained in the home market. Pernambuco is the largest producing State. In Sao Paulo, Minas Geraes, Rio de Janeiro and Santa Catharina mosaic has attacked the sugar plantations. The Ministry of Agriculture is therefore taking measures to combat this plague. According to that Ministry (May, 1926), "the improvement of methods of cultivation, irrigation, fertilizing and the creation and selection of varieties are rational measures which must be introduced in the cultivation of sugar cane to avoid its ruin."

PERNAMBUCO.

The 1925-26 sugar crop consisted of 3,033,506 bags of 60 kilos each, between the months of September, 1925, and June 30th, 1926, the major portion of which consisted of unrefined crystal and "demerara" sugar, the rest being muscovado low sugars. This crop has been shipped in its practical entirety to various ports in Brazil, Rio de Janeiro and Sao Paulo taking about 75 per cent. No sugar was shipped to any foreign port, owing chiefly to the higher prices obtainable in Brazil as compared with those in the large consuming countries of Europe and the United States of America. The prices obtained locally have been distinctly compensating to the sugar manufacturers, the average prices being about 45$ (26s.) per bag for crystal, 40$ (23s.) for "demerara," and 30$ (17s. 6d.) per bag for the lower grades. The stock on hand locally at the end of June, 1926, was calculated at about 100,000 bags.

The weather has been very favourable for cane-growing, and, should these conditions continue, the future crop should exceed that of the past season. At present it is calculated that the crop for September, 1926, to March, 1927, will equal and probably exceed that of the previous season ; about 3,700,000 bags is considered a reasonable estimate. Unfortunately, however, the growing canes in some districts have been attacked by mosaic, which has every appearance of spreading to other areas, unless the efforts of the State and planters in combating this disease are successful. Urgent measures have been taken, but the uneducated planter is not inclined to fall into line with the system suggested, and enforcement is difficult.

The question of the price obtainable for this crop is a difficult one, but it is believed that prices will show a very decided fall compared with those of the past crop, in view of the poor financial state of the country. No exportation is anticipated owing to the fact that home consumption is annually increasing.

In India 23 factories made 51,867 tons of sugar direct from cane during the season 1925-26, an increase of 18,602 tons over the previous year. The average yield per 100 maunds of cane rose from 7·81 in 1924-25 to 8·07 maunds in 1925-26.

Mr. HUBERT EDSON,[1] writing on "Mechanical Progress in the Cane Sugar Industry," makes a tilt against his chemist friends in the following words : "Finally it is a matter of profound moment to consider how relatively small has been the part of chemistry in the manufacture of cane sugar." Mr. EDSON, of course, is hardly serious, as he has both knowledge and experience to recognize the essential part of the chemist in every stage of cane sugar production, a part certainly not less impor tant than that of his colleague, the mechanical engineer. The contributions of the engineer and chemist to progress in our industry have been mutual, the one suggesting and assisting the part of the other.

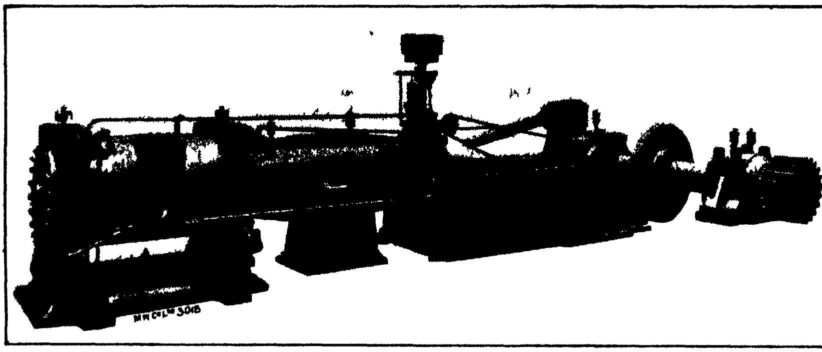
[1] *Facts about Sugar*, 1927, **22**, No. 10, 229-230.

Long-range Cut-off Gear for Corliss Engines.

Admission of steam into the cylinder of Corliss engines is regulated by the governor, not by throttling the pressure, but by varying the point of cut-off and thus regulating the quantity of steam admitted, in accordance with the power to be developed.

For a small power, steam is admitted for a short period (early cut-off), and for a greater power for a longer period (late cut-off), so that a relatively small or large quantity of steam is admitted in proportion to the power, and the maximum horse-power which can be developed depends upon the longest permissible period of steam admission.

Corliss engines with single eccentric valve gear, as usually installed in sugar factories, have a comparatively short period of steam admission—the maximum cut-off not quite reaching 40 per cent. of the stroke ; consequently the power for a certain size of cylinder is much less than for slide-valve or piston-valve engines in which a much later cut-off is obtainable. A larger size of Corliss engine is necessary for a given milling plant than that required for the other types of engines working under identical conditions of speed and steam pressure at the stop valve.



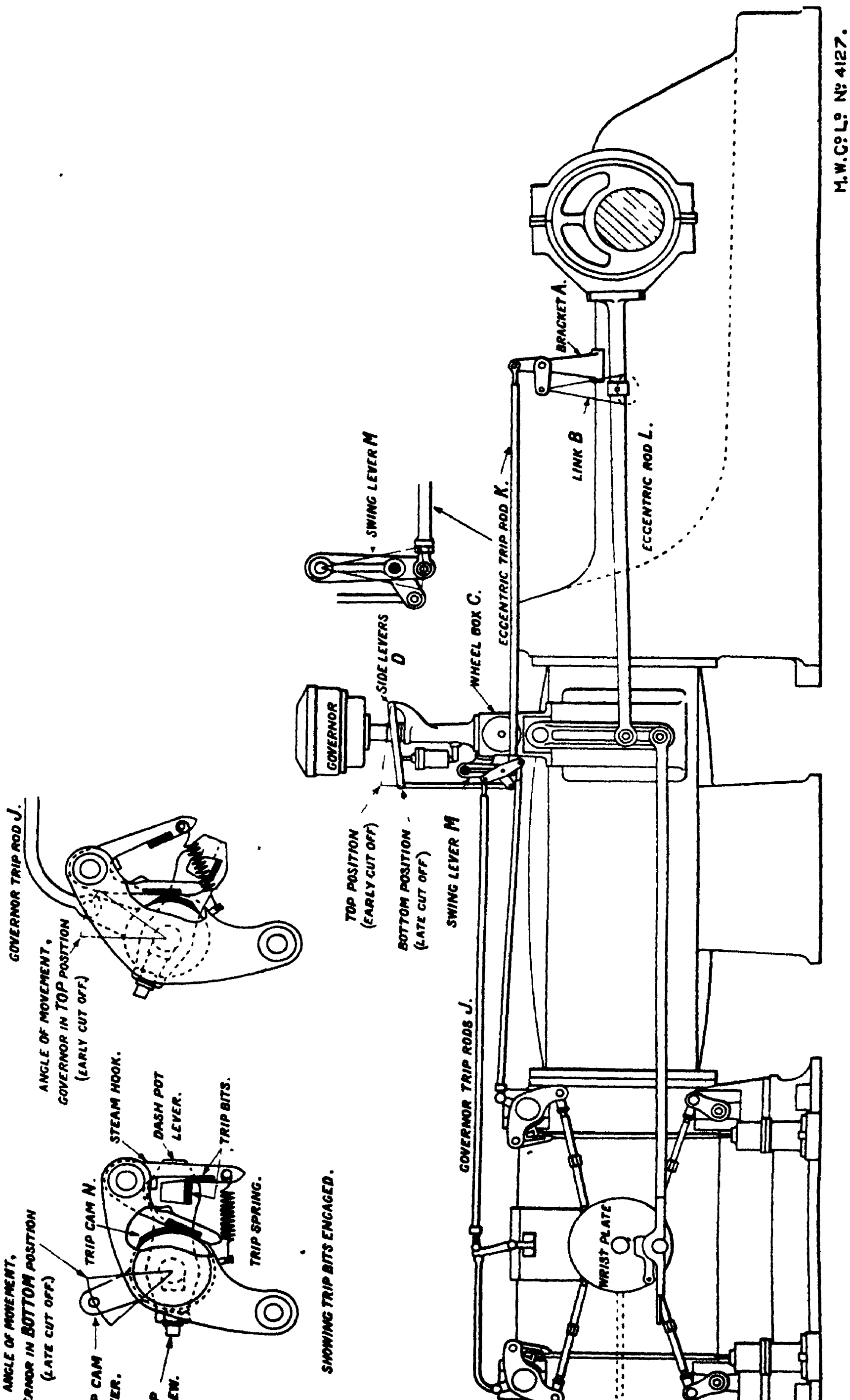
To overcome this feature of the Corliss engine, a long-range cut-off gear has been devised by the Mirrlees Watson Co., Ltd., Glasgow, and put into successful operation, by means of which the range of cut-off is increased so that later cut-off and greater developed power are possible. The arrangement and detail of such a gear, as fitted on a horizontal engine having cylinder 28 in. dia. × 54 in. stroke, is shown in the accompanying illustrations.

The limitations of cut-off in the usual single eccentric valve gears of Corliss engines are due to the fact that the position of the eccentric relative to the crank is determined by the requirements of the exhaust valves to open and close at certain points in the engine stroke. Tripping and rapid closing of the steam valves in such gears can only take place during an opening or forward movement of the steam valve lever and eccentric, because release of the detent or steam hook is effected by the trip gear being "wiped" or brought into contact with some stationary part, the position of which is regulated by the governor to suit the necessary cut-off.

To increase the range of cut-off, two courses are open :—

(1) To provide separate eccentrics at different angular positions on the crankshaft to serve the steam and exhaust valves so that their movements are independent. This, however, leads to a design of valve gear which cannot readily be operated when starting up or when reversing the engine, as is occasionally necessary in a sugar factory.

Long-range Cut-off Gear for Corliss Engines.



(2) To make additional use of the single eccentric movement in such a manner as to be equivalent to a second eccentric, and utilise this movement for tripping the steam valves at any point during both their opening and closing, or forward and return movements, thereby allowing a later cut-off, which takes place during the return movement. This method is accomplished by the long-range cut-off gear, in the manner described below.

Reciprocating motion is taken from the eccentric rod and transmitted by rods and levers to trip cams, which move to and fro instead of remaining stationary as in ordinary Corliss gears. This oscillating movement enables the trip cams to follow up the trip gear on the steam valve levers and cause tripping even during the return movement of the eccentric or the wristplate. The cut-off, or period of admission, is regulated by the governor which raises or lowers the side levers, so that the parts oscillating with the swing lever change the relative movement of the trip cams to a different angular position corresponding with the early or late cut-off, as is necessary, according to load on the engine.

The mechanism by which this is accomplished is shown in the diagram and consists of a bracket *A* with levers and pins actuated by a short link *B* coupled to the body of the eccentric rod *L*. The motion is transmitted by the eccentric trip rod *K* to a swing lever *M* carried by bracket attached to the governor wheel box *C* which supports the governor. The swing lever *M* carries the usual shaft and levers which transmit the movement of the governor side levers *D* to the governor trip rods *J* and trip cams *N*, but these rods also have an oscillating movement due to the swing lever *M*.

Enlarged views show the steam valve mechanism and movements of trip cam under the conditions of late cut-off and of early cut-off respectively, and further, on reference to the illustrations it will be seen that the steam valves are located at the top of the cylinder while the valves for the exhaust are those located at the bottom.

By the addition of the above-mentioned parts to the single eccentric valve gear, Corliss engines have an increased range of cut-off while no change is necessary to the exhaust valve gear which is operated in the usual way by a positive (non-tripping) movement derived from the same eccentric and wristplate which serve the steam valves.

Other parts of the valve gear mechanism are much the same as usual and the steam valves are closed, after tripping takes place, by the agency of dashposts and the rods connecting them to the back of the dashpot levers fixed on the oscillating spindles of the respective Corliss steam valves.

"When the sugar beet was introduced in Denmark, we soon found out that if a farmer had forty acres of land under cultivation, on which he had previously raised hay and grain for his dairy herd, and now devoted ten acres, or one-fourth of his total acreage to sugar beets, he still raised more hay and grain on thirty acres than he previously did on forty and also had his cash crop of beets from ten acres. The process was very simple: the deep-growing roots of the beets had gone down to new undeveloped regions of the soil and made bacterial life active there."[1]

Considerable use is being made in America of the Backhaus process of recovering the carbon dioxide evolved in fermentation. It consists in collecting the gas from the fermentation tanks, and, forcing by Root blowers through Field scrubbers and purifiers, which latter consist of cylindrical vessels fitted with coils, activated carbon being placed around these coils. After passages through these vessels a gas is obtained which is odourless and contain less than 0.1 per cent. of water. It is then compressed, and sold in cylinders, or as "snow."

[1] L. HERMAN in *Western Irrigation*, March, 1927.

Brevities.

Beets cultivated in different parts of the Union of South Africa[1] during the past three years showed an average sugar content of 17 per cent., and a yield of 10 tons per acre. The high and middle velds of the Transvaal are considered particularly suitable for this crop, the mild winter being a favourable factor.

Among new companies recently registered in the U.K. are the following: SHROPSHIRE BEET SUGAR CO., LTD., 87, Bishopsgate, E.C. 2. (221,067).—Public. To carry on the business indicated by the title. Nominal capital, £373,500 in 332,000 preferred ordinary shares of £1 and 332,000 deferred ordinary shares of 2s. 6d.

The promoters of the "Stream Line" filter have put on the market a laboratory model, costing less than £1. It is claimed to be handy and practical, to withstand rough usage, and to be found in many cases to compete with and even displace Buchner funnels and Gooch crucibles. It is said to afford rapid filtration, to be easily cleaned, and to use a medium with long life.

L. HERMAN, writing on beet cultivation in Denmark,[2] stated they had found in that country that the tonnage per acre can be increased without increasing the size of the beets, and they had now reached close to 16 tons per acre. A low yield of roots per acre with a low sugar content is not a climatic condition impossible to correct. It is an agricultural condition, always open to improvement.

HERSHEY REFINERY, Hershey, Cuba, has a melting capacity of one million lbs. per day, its output being a superior grade of granulated, sold for export as well as for local consumption. It is so constructed that it forms part of the original Hershey sugar factory built by the Hershey Chocolate Company in 1917-18. With the exception of the char-house, which is in an independent building, all of the refinery equipment is installed in an extension to the original factory building.

Streptococcus mesenterioides, or as better known, *Leuconostoc mesenterioides*, and *Clostridium gelatinosum* in 1924-25, caused considerable trouble in Czecho-Slovakian beet factories by the formation of mucilaginous matter in juice pipe-lines,[3] where the former was found to withstand a relatively high temperature, higher than is usually stated to be its thermal death-point. Lime was found to exert really only a small effect on both; but both were successfully checked by means of sulphur dioxide solution.

In the Loriott method of preparing absolute alcohol, which has now been adapted to large-scale production, and is in operation by several important manufacturers of chemicals and explosives, the vapours are passed through caustic lime for their dehydration. Steam consumption is stated to be 8500 lbs. of steam per 1000 gallons of absolute alcohol; while the lime used amounts to 3000 lbs. per 1000 gallons, which latter can be sold as slaked lime. The plant is constructed of steel, and is said to be compact and simple.

THE NATIONAL SUGAR REFINING COMPANY has purchased the refinery of the Warner Sugar Corporation at Edgewater, New Jersey. It is reported that the price paid for the property was approximately $7,000,000. Its daily melting capacity is 4,000,000 lbs. of raw sugar, with a daily production of 11,000 barrels of refined. The Yonkers and Long Island plants of the National have a daily capacity of about 6,500,000 lbs. of raws and 18,000 barrels of refined, making the combined capacity 10,500,000 lbs. of raws and about 29,000 barrels of refined.

DR. WM. A. TAYLOR, Chief of the Bureau of Plant Industry, Washington is reported as having stated when justifying a $7500 appropriation for the study of the artichoke that it is possible this plant might to an extent displace the cane and the beet in the U.S.A. It was claimed for the artichoke that more sugar per acre could be raised from it than from either cane or beet, and that virtually no cultivation is required. It would not necessarily follow, he explained, that both cane and beet sugar would disappear when artichoke sugar (levulose[4]) was being produced in commercial quantities, as these are different sugars with different sweetening powers.

[1] *S.A. Sugar J.*, 1926, 10, 705-707. [2] *Western Irrigation*, March, 1927.
[3] *Zeitsch. Zuckerind. Czecho-Slov.*, 1927, 51, 161-169, 170-189.
[4] Refer to *I.S.J.*, 1926, 212, 330, 608.

Review of Current Technical Literature.[1]

RECENT RESEARCH ON THE PRODUCTION OF POWER ALCOHOL FROM CELLULOSE. *Report of the Fuel Research Board of the Department of Scientific and Industrial Research.* 1927.

Most vegetable matter available for the production of power alcohol consists primarily of a mixture of cellulose, hemi-cellulose and ligno-cellulose. It is not likely that one type of micro-organism will be found, at all events in the near future, which will convert all three substances into alcohol. Attention is being concentrated on the direct fermentation of hemi-celluloses and cellulose, in the former case particularly on the direct fermentation of pentosans with a view to avoiding the utilization of inorganic acids for their conversion into pentoses. As regards the direct fermentation of cellulose, progress has been made in the selection of pure cultures of rapidly fermenting thermophilic types. In view of the possibility of success in this direction, inquiries are being made to locate within the Empire types of organic matter containing high percentages of unlignified cellulose. Further progress has been made in connexion with the determination of the optimum conditions for hydrolyzing pentosans and the fermentation of the resulting pentoses, the more important factors influencing the final results being the intervals of time for the successive adjustments of the *pH* concentration and the concentration of the mash. A new method for the sterilization of the mash by spraying is being experimented with; if satisfactory, it would result in a saving of time, a reduction in the size of the plant, and less handling of the material, thereby reducing the risk of infection. A small sample of dried sisal pulp obtained from Kenya has been examined, and after hydrolysis gave a yield of 6·7 to 11 per cent. of fermentable sugars, produced mainly from the insoluble pentosans. The yields of alcohol-acetone obtained from the hydrolyzed material varied between 6·7 to 11 gallons per ton of dried pulp. At the request of the Imperial Institute, experiments have been carried out on arrowroot residues sent over from St. Vincent. It was found that yields amounting to 53 gallons of the 96 per cent. ethyl alcohol would be obtained in the fermentation of the material by yeasts, after preliminary hydrolysis of the starch present by mineral acids. When using the Boulard process, the disintegrated material, when suitably diluted, gave a yield amounting to 37 gallons, of 95 per cent. ethyl alcohol per ton of disintegrated material. A binder made from straw and other vegetable substance has been developed to some extent by the Pulp Binders Development Co., of South Africa, and the process is connected on the bacteriological side with the manufacture of artificial stable manure, which is being developed elsewhere for agricultural purposes. Preliminary laboratory experiments are promising, and it seems possible that the method may produce a cheap and effective binder for making briquettes from coal dust.

USE OF CHLORINE FOR THE PURIFICATION OF BEET JUICES. **O. Spengler and R. Weidenhagen.** *Vereins-Zeitschrift*, 1927, No. 845, 119-121.

When chlorine is introduced into juice, hydrochloric and hypochlorous acids are formed, this having two advantages, namely, the *pH* of the solution is made favourable for the flocculation of the colloids, and the oxygen liberated from the hypochlorous acid exerts a bleaching effect. If one operates at a sufficiently low concentration of chlorine, namely about 0·02 normal, and at a low temperature, inversion by the acids formed is practically precluded, whilst the sucrose is quite resistant to chlorine. But difficulty commences when one filters and evaporates, inversion and increased colour being the result. If one were to neutralize the acids by alkali, then the salt content of the juices is increased, and molasses-forming substances are formed. OCHI,[2] however, finds in activated carbon the means of avoiding this difficulty, the residual chlorine as well as the greater part of the hydrochloric acid being adsorbed by this medium, so that for neutralization only an insignificant amount of alkali is required. In addition, the carbon exerts a marked decolorizing effect in the acid solution, juices that are colourless, or practically so, which can be concentrated without fear of inversion, being thus obtained. During

[2] *I.S.J.*, 1926, 332, 569.

the last beet campaign, experiments were carried out by the authors at the Institut für Zuckerindustrie, Berlin, on the value of this procedure, juices being taken from the experimental diffusion battery of the Institut, and the chlorination process carried out as prescribed by its inventor. At the same time control tests were made, using 2·5 per cent. of lime calculated on the roots, the usual amount added in the factory. It was found that on treatment of the raw juice with chlorine and 2 per cent. of "Norit" the purity was 90·8°, whereas with 2·5 per cent. of lime it was 94·2; on liming previous to carbonation, in order to reach the purity given by 2·5 per cent. of lime, it was found necessary to add 5 per cent. of "Norit" after the chlorination treatment, though it was noticed that if more than 5 per cent. were added, then the purity was not raised, but on the contrary was lowered. It therefore appears that on the basis of the purity the new process is hardly as advantageous as the old. There remains, however, the possibility of being able with the aid of the Ochi process to remove the colloids and colouring substances from beet molasses, and in this way to obtain a crystallizable product. In fact it was possible on diluting molasses in the proportion of 1 : 3 of water to make it water-white and colloid-free by chlorination and carbon treatment, but in consequence of the powerful buffering of the molasses it was not possible to obtain neutral or almost neutral solutions, the addition of alkali being necessary, with other consequent considerable increase of the melassigenic substances. Experiments were conducted with a turbine mixer for the purpose of thoroughly incorporating the chlorine with the molassses and so diminishing the chloride consumption that only a small amount of acid was formed. This failed completely, as the molasses solution was only transformed into a frothing mass, which no longer reacted and could not be filtered. Much the same result was obtained in the case of the juice, though it contained less frothing substances. It is therefore concluded by these authors that there is no prospect of utilizing this process in the German beet sugar industry.

DETERMINATION OF ASH IN SUGARS USING THE ELECTRICAL CONDUCTIVITY METHOD. **A. R. Nees.** *Industrial and Engineering Chemistry*, 1927, **19**, No. 2, 225-226.

Apparatus used by the author is of the type which utilizes the current from a 110-volt, 60-cycle lighting circuit. It consists of a one-to-one transformer, the purpose of which is to prevent injury to instruments through grounding of the circuit; an alternating current galvanometer; a dial-type Wheatstone bridge, and a conductivity cell.[1] the use of the galvanometer instead of the telephone receiver being a decided advantage. The dial-type Wheatstone bridge is much more convenient than the usual slide wire and resistance box "hook-up." While apparatus of this type is not of the highest precision, it is rugged and dependable and will give a higher degree of accuracy than is ordinarily demanded in process control work. The manipulation is simple and rapid; one man and a helper frequently make one hundred and fifty determinations in eight hours. Determinations are carried out at 25°C. using a solution containing 25 grms. of sugar per 100 ml. But the temperature control is quite important and for routine work where a large number of samples are to be tested, a thermostatically controlled water bath is necessary. If only occasional samples are being run, it is quite satisfactory to take about three readings between 24° and 26°C. and determine the reading at 25°C. by graphic interpolation. It is convenient to express all results in terms of specific conductance (as multiples of 10^{-5}) and to translate this figure into terms of ash and purity as occasion demands. The calculation is made according to the equation: $L=\frac{C}{R}$ where L=specific conductance, C=conductivity cell constant, and R=resistance. A correction is made in the usual way for the conductance of the water. It is advisable to use freshly distilled water having a specific conductance of about $0·25 \times 10^{-5}$ reciprocal ohms, but specially prepared conductivity water is not necessary. The constant of the conductivity cell is determined by using a 0·001 N potassium chloride solution, the specific conductance of which is taken as $14·72 \times 10^{-5}$ at 25°C., the proper water correction being also made in this case. The relation between

[1] Zerban and Mull, *I.S.J.*, 1926, 364; Tödt, *I.S.J.*, 1925, 503; Lunden, *I.S.J.*, 192 , 671.

specific conductance and ash was determined by comparing the conductance figures with the ash as determined in the usual way for a large number of samples of varying ash content. This relation was found to be a straight-line function over the range ordinarily encountered in refined sugars. Later determinations of ash showed the established relation to be reliable within the limits of accuracy of the direct method. The slope of the line was found to be such that $\tan\theta = 231{\cdot}5$ when specific conductance $\times 10^{-5}$ is plotted as ordinate and percent. ash as abscissa. Therefore the percent. ash may be determined by dividing the specific conductance $\times 10^{-5}$ by 231·5. This value was determined for average beet sugars produced in Colorado, Nebraska, and Montana, and would undoubtedly be applicable to any beet sugar containing ash of similar composition. The ash-conductance relation for refined cane sugars has not been investigated. It is probably slightly different from that found for beet sugars because of the relatively large percentage of highly ionizable alkali salts present in the ash of these sugars. Some results showing the effect of sugar concentration on the specific conductance were obtained, it being observed that the conductance is near the maximum at a concentration of 25 grms. per 100ml.

VARIATION OF SPECIFIC CONDUCTANCE $\times 10^{-5}$ WITH CONCENTRATION.

SUGAR	CONCENTRATION, GRMS PER 100 ML.						
	5	10	15·0	20	25	35	50
Pure	0·025	0·035	0·039	0·039	0·037	0·021	—
A	2·200	3·900	5·200	6·100	6·600	6·700	6·400
B	—	14·000	18·300	21·500	22·900	23·700	19·100

and that the variation of conductance with concentration is very slight. This fact influenced the choice of this concentration for regular use because extreme accuracy in weighing and dilution is obviously unnecessary. There remain to be determined some very interesting fundamental data concerning the effect of sugar on the dissociation constant, and of other factors such as viscosity which influence the conductance of solutions of inorganic salts. Undoubtedly a study of these factors will lead to wider applications of the method in refinery and beet-house practice.

PRODUCTION OF ALCOHOL FROM VEGETABLE MATTER (INCLUDING BEET TOPS, CROWNS, AND SLICES). **Sir Frederic Nathan.** *Presidential Address to the Institution of Chemical Engineers*, 1927.

Work on a process, chemical in its initial stages, for making alcohol from the cellulose of tropical and semi-tropical vegetation had been carried very far. It could now be said that, so far as the fermentation process was concerned, an inexpensive and readily controlled pure culture method had been worked out by which the hemicelluloses present in the materials could be converted into a mixture of alcohol and acetone. On the other hand the hydrolysis process, while presenting no difficulties in the laboratory, or even in the intermediate scale unit, could not be performed on a manufacturing scale, as autoclaves of acid-resisting materials were not obtainable of sufficient size. It was decided therefore by the Department of Scientific and Industrial Research to ascertain whether less complicated methods could not be devised. For this purpose it was determined to investigate the effect on the pentosans of low temperature and of a minimum quantity of liquid of high hydrogen ion concentration. As a result of these investigations, the following procedure was evolved for working a tank of 160 galls. capacity : Raw material was (if necessary) cut into a convenient size, and steeped for four to six hours at ordinary temperature in a 2 per cent. solution of sulphuric acid in the proportion of 1 to 10. Then the surplus acid was drawn off, leaving in the material from 1·5 to 3 times its own weight of diluted acid, which quantity could be considerably reduced by the introduction of suitable presses. The damp material was next treated for seven hours with live steam, the effect of this on the acid-soaked material being sufficient to destroy all micro-organisms and their spores. Subsequent extraction of the pentoses was carried out under aseptic conditions and with sterile water collected from the excess steam used in the hydrolysis, thus securing a sterile mash without the need of a special pressure sterilization process. Heating the material under pressure,

whether it was acid or neutral, was entirely eliminated and the process was simplified in important directions. Further, a solution of pentoses was obtained which in its fermenting qualities was found to be equal, if not superior, to the solution prepared by pressure boils. Use of beet waste materials, supplemented possibly by small, damaged and surplus potatoes, for the manufacture of alcohol for use as a fuel on the sugar beet farms had been investigated at the Bacteriological Laboratory of the Royal Naval Cordite Factory and the results had indicated that these products could be made to yield alcohol not only from the natural sugars, but also from the pentosan portion of their composition. Approximate yields obtained so far on a laboratory scale were as follows :—Tops, as collected, 4½ galls. ; dry, 30 galls. per ton. Crowns, as collected, 13 galls. ; dry, 53 galls. per ton. Extracted slices, dry, 35 galls. per ton.

RELATIVE SWEETNESS OF SUCROSE AND LEVULOSE. **J. J. Willaman.**[1] *Communicated to this Journal.*

SPENGLER and TRAEGEL conclude that fructose has a sweetness of 108, if sucrose is rated as 100, a value so decidedly different from 173. assigned by BIESTER, WOOD, WAHLIN, and WILLAMAN in 1925.[2] The former used a 4 per cent. sucrose solution as a standard, and compared it with 3·8, 3·6, and 3·4 per cent. levulose solutions, a number of people being asked to taste first the sucrose and then one of the levulose solutions, and in this way decide which levulose solution had the same sweetness as the sucrose. But in the method of BIESTER *et al* (the Minnesota method) the subject rinsed her mouth with 15 c.c. of distilled water, the end of her tongue was dried with cotton, and one drop of one of the sugar solutions placed on the tongue, the result being reported as "sweet," "doubtful," or "not sweet." About 20 women took part in the tests. In this way, there was determined for each sugar the "threshold" concentration, i.e., the lowest concentration which was detectably sweet to all the experimental subjects. In the latter method the memory of a sweet sensation is not involved, as within a few seconds the subject can make her decision, and she merely decides whether the solution was sweet or not sweet. On the other hand, the method used by SPENGLER and TRAEGEL, involves remembering how sweet a previous solution was until the next solution is tasted, whereas taste images are weaker, more transient and fluctuative than are images from other senses. Determination of the "threshold" concentration seems therefore to be a far more accurate index of sweetness than would the comparative method. Tap water and the addition of sodium chloride was used by the German investigators. But it is contrary to the principles of quantitative methods to confuse a taste sensation by bringing in another and different taste sensation. To be sure, SPENGLER and TRAEGEL claim that their accuracy is increased by so doing, but this indicates still further a lack of acuity in their method. They then go on to state : "The manufacture of large quantities of it (levulose) in a pure, crystalline condition has been hindered by considerable difficulties which appear in the method, and by the low yields which make the manufacture appear unfeasible, although possibility of a technical achievement of fructose production is not disputed." But the writer (Prof. WILLAMAN) feels it would be a great mistake for the sucrose industry to sit complacently and watch the development of the levulose industry, under the mistaken idea that it is only slightly sweeter than sucrose, and that, therefore, it will not be a serious competitor. He is convinced that it is a far sweeter sugar ; and that, on this basis alone, it can become a strong competitor of sucrose.

SOME NOTES ON THE INFLUENCE OF FILTER-PAPER ON THE POLARIZATION OF SUGAR SOLUTIONS. **K. Vnuk.** *Zeitsch. Zuckerind. Czecho.*, 1926, **51**, 125-128, 133-139. In filtering sugar solutions for their polarization, the moisture present in the paper may exert a sufficient effect on the concentraton of the liquid to cause an error in the reading.[3] If the paper contains less than 7 per cent. of water, then the solution becomes concentrated; but if, on the contrary, if it is greater than this

[1] University of Minnesota, St. Paul, Minn., U.S.A. [2] *Am. J. Physiol*, 73, 387, 397.
[3] See HARDIN and ZERBAN, *I.S.J.*, 1925, 53-54

figure, then the solution is diluted. Paper containing 7 per cent. of water can be obtained by keeping it in a desiccator over a saturated solution of ammonium thiocyanate.—NEW H.I.C. INDICATORS. **Barnett Cohen.** *Public Health Reports*, 1926, **15**, 3051-3074. Six new compounds are described of the sulphonephthalein series which are of value as indicators in volumetric analysis and as reagents for the colorimetric determination of hydrogen-ion concentration. They have the following scientific names, proposed common names, useful *pH* range, and colour change in passing from acid to alkaline : Tetrabrommetacresolsulphonephthalein (brom cresol green[1]), 3·8 to 5·4, yellow to blue ; Tetrachlormetacresolsulphonephthalein (chlor cresol green) 4·0 to 5·6, yellow to blue; Dibromphenolsulphonephthalein (brom phenol red), 5·2 to 6·8, yellow to red ; Dichlorphenolsulphonephthalein (chlor phenol red), 4·8 to 6·4, yellow to red ; Dibromdichlorphenolsulphonephthalein (brom-chlor phenol blue), 3·0 to 4·6, yellow to blue ; Metacresolsulphonephthalein (metacresol purple) with a dual *pH* range and colour change, i.e., 1·2 to 2·8, red to yellow, and 7·4 to 9·0, yellow to purple.—REPORT OF THE NEW YORK SUGAR TRADE LABORATORY, 1926. **F. W. Zerban,** *N. Y. Sugar Trade Lab. Inc.*, 80, South St. New York, U.S.A. Dr. ZERBAN reports that : " The average polarization of all samples was 96·11, the same as the year before. The highest monthly average was 96·42, and the lowest 95·79, the difference between the two being 0·63, or the same as in 1925. The percentage of samples testing between 96° and 97° has again risen further, from 58·65 in 1925 to 59·25 in 1926, while that of samples polarizing between 95° and 96° has declined from 26·47 in 1925 to 25·33 in 1926. However, the relative number of samples polarizing below 95° has slightly increased, from 7·07 per cent. in 1925 to 7·32 per cent. in 1926."—REMOVAL OF PRECIPITATES FROM SETTLING TANKS. **H. Steen,** *Chemiker Zeitung*, 1926, **50**, 961-962. It is often advantageous if the sediment is drawn off instead of removing the bulk of clear liquid. This can be effected in an cylindrical tank (here described) with a conical bottom, a pressure vessel being connected to the sludge outlet-cock to balance the liquor head. Several conical sumps so arranged may be connected to one large tank.—DETERMINATION OF WATER IN SUGAR, ETC., BY DISTILLATION WITH XYLENE. **J. Pritzker and R. Jungkunz.** *Chemiker Zeitung*, 1926, **50**, 962-963. An apparatus, claimed to make possible the accurate determination of water by continuous distillation with zylene, has a cooler of the internally suspended type with outer vapour jacket. The turbid distillate is collected in a tube, which is centrifuged.—RELATIVE SWEETNESS OF SUCROSE AND LEVULOSE. **O. Spengler and A. Traegel.** *Zeitschrift des Vereins der deutschen Zucker-Industrie*, 1927, 1-12. Paul's value[2] for levulose was 103 with sucrose as 100. But DEERR[3] found 150, WILLAMAN[4] and others, 173·3, and the Water Laboratory of the U.S. Department of Agriculture,[5] has stated 150 Tasting experiments carried out by eight or nine persons now show the value to be 108 only. the same value practically being found whether the solutions were made with distilled water, with tap water, or with tap water in which 0·05 per cent. of salt was added.—NEW APPARATUS FOR THE ELECTROMETRIC DETERMINATION OF ASH IN SUGAR FACTORY PRODUCTS. **K. Sandera.** *Zeitsch. Zuckerind. Czechoslov.*, 1927, **51**, No. 22, 205-211. A scheme of optical instead of the more usual telephonic indication of the balancing of resistances in a bridge is proposed. A.C. from the mains (120 volts and 50 periods) is divided into four resistances, the first two of which comprise a pair of lamp bulbs and the other two the liquid being examined and a constant resistance device. On altering the distance between the platinum electrodes composing the cell containing the solution of the sugar under examination, the resistance in the circuit is altered and can be balanced with the constant resistance, the two lamps being equally illuminated at the point when equilibrium exists in the system. Then the ash content is read from a scale calibrated by means of solutions of known content in mineral matter. Apparatus on this principle is said to have given results differing from those found by the usual gravimetric method by 0·02 in the case of 68 per cent. of the raw sugars examined, and by 0·04 only in four cases.

J.P.O.

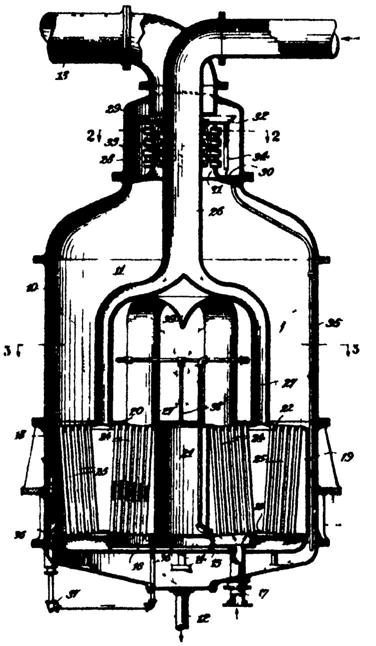
[1] This indicator has already found use.
[2] *Chem. Zeit.*, 1921, 705. [3] *I.S.J.*, 1922, 481. [4] *I.S.J.*, 1925, 559. [5] Through *Centralbl.*, 31, 626.

Review of Recent Patents.[1]

UNITED STATES.

Evaporator. Gustav Nickolai, of New York, U.S.A. 1,611,059. December 14th, 1926.

Some of the objects of the present invention are: to maximize the thermal efficiency as a result of a more effectual distribution of the heat or steam; to obtain a more thorough vapourization of the liquid or juice by causing a novel entrainment of the liquid or juice; to maximize the circulation without any unnecessary conflict between the ebullient liquid and the liquid in the tubes; to obtain a more effectual deflection of the ebullient liquid and vapours so that they will be impinged against a metal wall before escaping, giving the bubbles carried with the vapours a chance to break; to attenuate the escaping vapour and the ebullient liquid; to cause the particles not capable of gasification to be impinged against a metal body to obtain thorough disintegration, and to make provision for draining condensate, and the liberation of gases and pressure which might interfere with the proper action in the evaporator. Referring to the drawing, the evaporator will include a vessel 10 any desired construction and size consistent with the arrangement of the other parts arranged within the chamber 11. Communicating with this chamber is a syrup outlet 12 and a vapour outlet 13 which leads to a vacuum pan. Supported in any suitable manner as at 14 is a pan 15, and supported above it to any preferred degree is a pan 16 of annular construction, and leading to the latter is a liquid inlet 17. Superposed over receptacles 15 and 16 js a calandria, which consists of a hollow body 19 annular in construction, to provide a chamber 20 and a passage 21 located centrally of the shell, and substantially centrally of the chamber 11. Arranged between and opening through the walls 22 and 23 of the shell 19 is an annular series of tubes 24 which are nested together as closely as possible· It will be noted that these tubes are disposed at an angle with respect to a vertical plane and are inclined upwardly and inwardly with respect to the central vertical axis of the vessel 10. It will be further noted that the lower ends of the tubes 24 are opened to the receptacle 16. Surrounding the series of tubes 24 is an annular series of tubes 25 which are arranged between the walls 22 and 23 and open therethrough. The tubes 25 are arranged at an angle with respect to a vertical plane and are inclined upwardly and outwardly with respect to the central vertical axis of the vessel 10. It will be further noted that the lower ends of the tubes 25 are opened to the receptacle 15, and that the upper ends of the tubes 25 are opened to the chamber 11 similarly to the tubes 24. In order to heat tubes 24 and 25, there is provided a steam conduit 26 which enters the chamber 11 and has a number of branch conduits 27, there being six in the present instance, each of which communicates with the chamber 20 of the shell 19. It will be noted that each branch conduit 27 communicates with the chamber 20 between the inner series of tubes 24 and the outer series of tubes 25, as shown clearly in the drawing. In order to deflect or to cause the impingement of any particles which have not been disintegrated in the chamber 11, there is provided at the top of this chamber a means



[1] Copies of specifications of patents with their drawings can be obtained on application to the following—*United Kingdom*: Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C 2 (price 1s each). Abstracts of United Kingdom patents marked in our Review with a star (*) are reproduced from the *Illustrated Official Journal (Patents)*, with the permission of the Controller of H.M. Stationery Office, London. Sometimes only the drawing or drawings are so reproduced. *United States*: Commissioner of Patents, Washington, D.C. (price 10 cents each). *France*: L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris. *Germany*: Patentamt, Berlin, Germany.

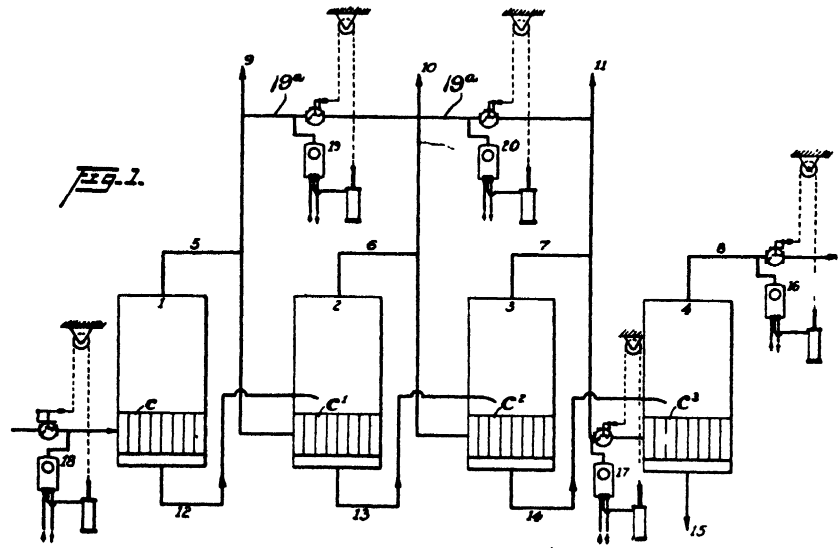
28 for that purpose. This consists of a casing 29 which provides a bottom 30 and a flue 31 which surrounds the conduit 26. A pan or receptacle 32 is arranged on the top of the flue 31 and closes the upper end thereof. Radiating from the wall of the flue 31 are short tubes 33 which establish communication between the chamber 11 and the outlet 13. Any condensate falling into the receptacle 32 is drained therefrom by a drain pipe 34, and any condensate in the chamber of the casing 29 is drained therefrom by virtue of a drain pipe 35 which communicates with the interior of the casing 29 and leads to the bottom of the chamber 11. In order to drain any condensate in the chamber 20 there is provided a number of tubes 36 which communicate with said chamber and lead to a common outlet pipe 37. Air and gas outlet pipes 38 are also employed for liberating the same from the chamber 20 when steam is first introduced to the chamber 20. Saccharine juice enters the receptacle 16 through the inlet 17 and rises in the lower ends of the tubes 24. Steam is admitted to the chamber 20 which will cause the liquid in the tubes 24 to move upwardly and out through the upper ends of the tubes 24 due to the difference in temperature of the liquid and the heat retained by the tubes 24. The liquid in a condition of ebullition courses upwardly and inwardly and owing to the disposition of the tubes is deflected in part by a baffle 39; the vapour rising and the remnant falling through the passage 21 to the receptacle 15 from which it enters the lower ends of the tubes 25. The liquid entering the lower ends of the tubes 25 will have cooled to some extent and being brought into the presence of the heated tubes 25 will move upwardly and outwardly of the chamber 11; the vapour rising and any remnant will pass downwardly to the bottom of the vessel 10 and will pass out through the outlet 12. The vapour passes upwardly and is attenuated and kept from condensing by the heat of a portion of the conduit 26, while the ebullient liquid is constantly heated by the branch conduits 27, thus maximizing vapourization. All the vapour passes through the tubes 33 to the outlet 13 from which it passes to the vacuum pan. Any particles carried up by the vapour will be impinged against the wall of the casing 29 to cause further separation from the vapour. From the foregoing it should be obvious that loss of heat by radiation is reduced to the minimum; that choking of the tubes 24 and 25 is prevented due to the manner in which the liquid is sent out of the tubes; and that air will be almost entirely excluded.

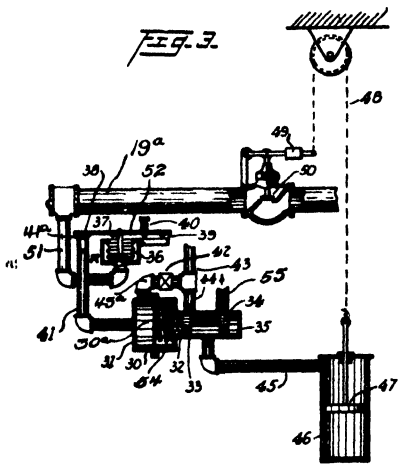
MANUFACTURE, APPLICATION, AND REVIVIFICATION OF ACTIVATED (DECOLOURIZING) CARBON. (*A*) **Edouard Urbain**, of Paris, France. 1,610,399. December 14th, 1926. (*B*) **Wm. B. Alexander**, of Plainfield, N.J., U.S.A. 1,610,408. December 14th, 1926. (*C*) **Oscar L. Barnebey**, of Detroit, Mich., U.S.A. 1,614,913. January 18th, 1927. (*D*) **Oscar L. Barnebey**, of Detroit, Mich., U.S.A.; and **Merritt B. Cheney**, deceased, late of Briggsdale, Ohio, U.S.A. 1,614,707. January 18th, 1927. (*E*) **Fred B. Arentz** (assignor to **U.S. Industrial Alcohol Co.**). 1,616,073. February 1st, 1927.

(*A*) Manufacturing active carbon comprises the steps of impregnating cellulosic material with a substance of acid reaction comprising oxygen and phosphorus in chemical combination, and thereafter heating the material above 700°C. and until there is a substantial evolution of phosphides. (*B*) This process comprises calcining, while excluding air therefrom, carbonaceous clay in it snatural moist state. (*C*) In a process of treating vegetable carbonaceous materials to separate and recover constituents thereof, claim is made for the steps which comprise carbonizing said materials, thereafter heating the carbonized product in the presence of chlorine so as to volatilize and separate certain of the chlorides thus produced, extracting soluble chlorides remaining in the residue, and washing the residual carbon free from impurities. (*D*) A process of making adsorbent carbon consists in heating at carbon-activating temperatures carbonaceous material and steam and generating therefrom gaseous reaction products of higher CO_2 content than CO content. (*E*) A process for revivifying an absorbent material consists in applying live steam thereto and then removing any residual condensed and uncondensed steam by applying a gaseous non-supporter of combustion thereto, in such a manner as to remove odorous impurities therefrom and restore its capability of removing such odorous impurities.

EVAPORATOR PLANT OPERATING WITH HIGH PRESSURE STEAM. **Julius Mugler,** of Berlin, Germany. 1,598,301. August 31st, 1926.

In modern evaporator plants which work with high steam pressure, the condenser is omitted, the steam in that case being conducted to other steam consumers, after it has done its work in the evaporators. In such evaporator plants, because of variations in the steam consumption, the pressure in the last evaporator will either rise above or drop below the desired point with the result that the final density of the material under evaporation varies, and, when the pressure rises too high in the





last evaporator, steam must be blown off. In accordance with the present invention, there is provided besides the regular evaporators an additional unit, which may operate either as another evaporator or merely as a part through which the material under treatment may pass, there being overflow pipes or by-pass connexions for the vapours between the various units, which overflow pipes are equipped with automatic regulators so that steam of higher pressure of one unit may be supplied to the next succeeding units, a further regulator being provided between the additional unit and other steam-consuming devices. Where the amount of the material to be

evaporated and the density are not always the same, further means are required to keep the evaporation constant so as to prevent various degrees in the density of the final product. To this end, in the steam or vapour pipes a special valve is provided which automatically regulates tho steam or vapour by means of an automatic density regulator controlled by the density of the evaporated material. According to Fig. 1, the plant comprises the well-known evaporator units 1, 2 and 3, adapted to receive clarified juice. Fresh steam is supplied to the heating chamber C of the evaporator 1, the hot vapours arising from the juice in evaporator 1 passing through the pipe 5 into the heating chamber C^1 of the evaporator 2, while the hot vapours arising from the juice in evaporator 2 pass through the pipe 6 into the heating chamber C^2 of evaporator 3. Surplus steam or vapours pass from the evaporators through the pipes 9, 10, 11 respectively to other steam or heat-consuming apparatus (not shown). In addition to the evaporators 1, 2 and 3 there is provided a further unit 4, to the heating chamber C^3 of which hot vapours may be supplied at certain times from evaporator 3 through pipe 7. The pipe 7 is provided with an automatic regulator 17 and a similar regulator 16 is provided in the steam or vapour discharge pipe 8 of the unit 4. Evaporated sugar juice is successively pumped through the pipes 12, 13, 14 from one evaporator to the next and finally into the additional unit 4, from which it is discharged through the pipe 15 connected to a pump (not shown). If, because of too small a withdrawal of steam or vapours by consumers from the pipes 9, 10 and 11, the pressure in the evaporator 3 rises to above a predetermined point the automatic regulator 17 is caused by the rise of pressure to operate to admit steam or vapours to the heating chamber of the unit 4, which heretofore acted only as a passage for the evaporated sugar juice but now also begins to do work as an evaporator, so that the total efficiency of the plant and thereby also the density of the final product are kept constant. Should the pressure in the unit 4 also rise above a predetermined point, due to further lessened steam or vapour consumption through the pipes 9, 10, and 11, the automatic regulator 16, like the regulator 17 will be actuated by the excess pressure to let steam or vapours escape from the unit 4 either to a consumer, or a condenser, in case the temperature of the unit 4 is so low that the steam or vapour can not be utilized any further. The amount of steam or vapour in that case, however, will be only a fraction of the steam or vapour wasted in an evaporator plant of the usual construction, in which the additional unit for making use of the surplus vapours is lacking. Similar automatic regulators 19 and 20 like those shown at 16 and 17 are provided in the by-pass connexions 19^a connecting the pipes 9, 10 and 11 in Fig. 1. These latter regulators are provided to permit surplus steam or vapour of a unit of a higher stage to be supplied to the unit of a lower or succeeding stage, in case the steam or vapour consumption for other steam or vapour consuming devices should decrease while that of the next succeeding stage increases.

In Fig. 3 is shown in detail one type of automatic regulator. Reference character 19^a designates the connexion between conduits 9 and 10. Flow of vapour or steam through this connexion is controlled by a valve 50 operated by a servo-motor 46 which is in turn operated by a pilot valve 33, 34, which is in turn operated by a relay R which relay is responsive to changes of pressure in conduit 19^a ahead of valve 50. Changes of pressure in conduit 19^a are transmitted through tube 51 and act upon a bellows 36 which is connected to a lever 52 through the intermediary of a pin 37. Lever 52 carries at one end a baffing member 38 which is positioned over an opening 41^a in a conduit 41 which connects with the pilot valve housing. Lever 52 is pivoted at 39 and is acted upon by a spring 40, the force of which is opposed to the pressure of conduit 19^1 transmitted to bellows diaphragm 36. The pilot valve is supplied with fluid under pressure by means of conduit 43. This conduit supplies fluid both to the servo-motor and to the relay. The supply to the relay takes place through a branch conduit 43^a which contains a restriction 42. The fluid in flowing to the relay flows through a chamber 30^a one side of which is formed by a diaphragm 31 which is connected to the pilot valve 33, 34. Fluid pressure acts in chamber 30^a and is opposed by spring 54. The pilot valve 33, 34 affords connexion with the servo-motor 46 through conduit 45 with either supply conduit 44 which is connected to conduit 43 or a discharge conduit 55. Assume that the pressure decreases

in conduit 19^a. Lever 52 is then rocked to restrict outflow through opening 41^a. This causes a rise of pressure in chamber 30^b which moves diaphragm 31 to the right and connects conduit 45 with discharge conduit 55. The pressure of fluid on the upper side of piston 47 is then released and due to the weight 49 which acts upon valve 50, piston 47 moves upwardly and valve 50 closes. The pressure is thus returned to normal. Assume, on the other hand, that the pressure increases in conduit 19^a. This causes a rise of pressure force against bellows 36 which moves lever 52 so that baffling member 38 allows a greater outflow of fluid through opening 41^a and from conduit 41. Due to the restriction 42 this causes a drop of pressure in chamber 30^a which results in a movement of diaphragm 31 to the left and movement of pilot valve 33, 34 to the left whereby conduit 45 is connected with conduit 44 and pressure fluid is supplied to servo-motor 46 causing a downward movement of piston 47 which results in an opening of valve 50, thus returning the pressure to normal. It is thus seen that the valve 50 is so operated that the pressure in conduit 19^a in front of the same and therefore the pressure in conduit 9 is maintained constant.

Reduction of Sugars to Alcohol. **Henry J. Creighton,** (assignor to **Atlas Powder Co.,** of Wilmington, Del., U.S.A.). 1,612,361. December 28th, 1926. The electrolytic reduction of a sugar comprises disposing a non-acid electrolytic solution of the sugar to be reduced between the anode and cathode of an electrolysis cell.—Evaporator Tube Connectors. **Walter L. Badger** (assignor to **Swenson Evaporator Co.,** of Harvey, Ill, U.S.A.). 1,612,961. January 4th, 1927. Claim is made for the combination with a cylinder having a head and a plurality of tubes in the cylinder extending through the head, of a cover connected to the cylinder having passages therein for connecting pairs of said tubes to form coils, the cross sectional area of the inlet ends of the passages being greater than the cross sectional area of the discharge ends of the tubes and the cross sectional area of the outlet ends of the passages being less than the cross sectional area of the inlet ends of the tubes.—Revivifying Kiln. **Leon A. Tarbox** (assignor to the **Emlenton Refining Co.,** of Emlenton, Pa., U.S.A.). 1,613,299. January 4th, 1927. Spent material is passed through a passageway in indirect heat conductive relation with heating gases applied to the passageway, in introducing air to the material in the passageway at longitudinally spaced intervals while it is being heated in sufficient quantity to burn combustible carbonaceous material contained therein, and in maintaining the earth in a state of agitation during such treatment. Non-Corrosive Alcohol Composition. **Walter T. Schreiber** (assignor to **U.S. Industrial Alcohol Co.**). 1,613,808. January 11th, 1927. In combination, a metal container having therein a non-corrosive alcohol composition containing a soap forming material, which composition would corrode the container if said soap forming material were absent.—Sap Evaporator. **Samuel C. Nicols,** of Waddington, N.Y. 1,614,016. January 11th, 1927. A sap evaporator, comprising a liquid container, a heater mounted in the lower end of the container, a condensing chamber located above the liquid container and in communication therewith, a coil mounted within said liquid container, a spile arranged to flow the sap into said coil, and a syrup-receiving container connected at the lower end of the liquid container.—Distillation of Liquids. **John L. Major and Benj. Taylor,** of Bilston, England. 1,614,483. January 18th, 1927. In the distillation and evaporation of liquids, a method is claimed of feeding the liquid into the still consisting in passing the liquid in a plurality of streams of relatively narrow but substantially oblong cross-section through the body of the liquid in the still, the streams discharging above the body of liquid in the still and passing therein.—Distillation of Alcohol. **Elwood I. Clapp** (assignor to **U.S. Industrial Alcohol Co.**). 1,614,877. January 18th, 1927. The process comprises distilling an aqueous liquid containing alcohol and lower boiling impurities, withdrawing liquid alcohol and alcohol vapour, both at a higher concentration than the liquid being distilled, from the materials evolved in the distilling operation, conveying the liquid alcohol and alcohol vapour containing lower boiling impurities to a column and distilling the same so as to remove lower boiling impurities therefrom while recovering alcohol therefrom substantially freed from such lower boiling impurities.

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	One Month ending March 31st.		Three Months ending March 31st.	
Unrefined Sugars	1926. Tons.	1927. Tons.	1926. Tons	1927. Tons.
Poland	101	....	1,990	198
Germany	860	....	860	680
Netherlands	....	....	....	....
France	....	..	....	....
Czecho-Slovakia	.	315	....	927
Java	....	....	....	65
Philippine Islands	....	....	....	....
Cuba	9,271	22,126	52,640	44,470
Dutch Guiana	....	....	....	....
Hayti and San Domingo	7,026	15,694	12,295	23,026
Mexico	....	....	....	....
Peru	10,666	20,160	26,392	60,658
Brazil	....	2,298	95	15,655
Union of South Africa	600	401	14,338	4,022
Mauritius	61,243	26,738	121,725	66,381
Australia	32,614	2	105,951	14,754
Straits Settlements	....	..	....	....
British West Indies, British Guiana & British Honduras	5,059	4,467	17,797	12,250
Other Countries	1,995	2,525	5,288	7,285
Total Raw Sugars	**129,437**	**94,726**	**359,371**	**250,372**
Refined Sugars.				
Poland	730	52	5,226	3,487
Germany	1,305	371	2,598	4,459
Netherlands	30,271	26,761	60,964	43,120
Belgium	299	190	1,924	1,268
France	....	....	....	....
Czecho-Slovakia	22,042	9,209	64,612	44,580
Java	....	....	....	....
United States of America	1,188	4,876	1,842	6,221
Canada	5,365	9,466	14,210	18,692
Other Countries	248	2,979	7,945	3,639
Total Refined Sugars	**61,449**	**53,904**	**159,320**	**125,468**
Molasses	18,845	21,806	52,801	24,331
Total Imports	**209,731**	**170,436**	**571,492**	**400,171**

EXPORTS.

	Tons	Tons	Tons	Tons.
British Refined Sugars.				
Denmark	89	141	243	214
Netherlands	54	20	115	93
Irish Free State	4,330	2,789	14,713	8,302
Channel Islands	56	35	175	94
Canada	....	....	....	....
Other Countries	5,398	1,501	14,726	2,641
	9,927	4,484	29,973	11,344
Foreign & Colonial Sugars				
Refined and Candy	146	209	456	584
Unrefined	536	86	598	277
Various Mixed in Bond	....	....	....	..
Molasses	640	39	1,025	104
Total Exports	**11,249**	**4,818**	**32,052**	**12,309**

Weights calculated to the nearest ton.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1927. Tons.		1926. Tons.
Total Receipts, January 1st to April 27th	1,032,382	..	1,268,632
Deliveries ,, ,, ...	997,580	..	1,126,433
Meltings by Refiners ,, ,, ...	942,548	..	1,045,000
Exports of Refined ,, ,, ...	24,000	..	37,000
Importers' Stocks, April 27th	150,164	..	150,855
Total Stocks, April 27th	275,363	..	302,566
	1926.		1925.
Total Consumption for twelve months	5,671,335	..	5,510,060

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1925 1926, AND 1927.

(Tons of 2,240 lbs.)	1925. Tons.		1926. Tons		1927 Tons.
Exports	1,563,873	..	1,323,976	..	1,098,473
Stocks	802,936	..	1,193,158	..	1,310,348
	2,366,809		2,517,134		2,408,821
Local Consumption	45,000	..	35,000	..	26,000
Receipts at Ports to March 31st	2,411,809		2,552,134		2,434,821

Havana, March 31st, 1927. J. GUMA.—L. MEJER

Sugar Crops of the World.

(Willett & Gray's Estimates to April 27th, 1927.)

	1926-27. Tons.		1925-26. Tons.		1924-25. Tons.
CANE.					
America	8,299,779	....	8,66[illegible],415	....	8,877,329
Asia	6,186,957	....	6,308,484	....	5,661,027
Australasia	510,000	....	592,911	....	536,490
Africa	618,000	....	678,673	....	545,260
Europe...................	7,500	....	8,700	....	8,087
Total Cane...... ..	15,622,236		16,255,183		15,628,193
BEET.					
Europe...................	6,854,285	....	7,441,441	....	7,083,068
U.S.A....................	801,246	....	804,439	....	974,185
Canada	28,000	....	32,475	....	36,200
Total Beet	7,683,531		8,278,355		8,093,453
TOTAL CANE AND BEET..	23,305,767		24,533,538		23,721,646

United Kingdom Monthly Sugar Report.

Our last report was dated the 9th April, 1927.

There has been a recovery in prices since our last report but conditions have continued unsettled, owing to the prospect of large shipments of Javas to Europe.

The London Terminal Market has been very active and chiefly concerned with the liquidation of May. The knowledge that there was to be no change in the existing scale of duties in the Budget proved stimulating to the market, and confidence seemed once more restored, but has since been shaken by heavy sales of August against Javas. Large quantities of May have been transferred to August and New Crop. The New Crop does not appear to be pressing, although business is doing in small volume. May moved from 16s. 7½d. to 17s. 7½d. to 16s. 5¼d. to 17s. 1½d., August was traded in heavily from 16s. 11¼d. to 18s. 1½d. to 16s. 11¼d. to 17s. 4½d. October sold from 15s. 10½d. to 16s. 7½d. to 16s. 3d., whilst December fluctuated from 15s. 6d. to 16s. 3d. to 15s. 9¾d. March on the new basis moved from 17s.. 4½d. to 17s. 11¼d. to 17s. 6d. The latest prices are May 17s. 1½d., August 17s. 6d., October 16s. 3¾d., December 16s., and March 17s. 7½d.

The demand for actual sugar improved after the Budget. There have been occasional bursts of trade, but generally speaking there has been a poor demand.

Ready Czechos and Dutch Granulated sold up to 18s. 4½d., but recently down to 17s. 6d. again. The latest price is 17s. 9d. to 18s. June/August deliveries have been sold at about 4½d. premium. American and Canadian Granulated have not been pressing by first hand, but second hand has sold up to 18s. 10½d. c.i.f. The latest price is 18s. 7½d. White Javas have been freely offered, and at one time sold as low as 16s. 9d. c.i.f. Although not much business has been done with the United Kingdom it is estimated that Europe has already bought 100,000 tons of this sugar. Spot Granulated sold from 30s. 7½d. to 31s. 3d. and down again to 30s. 6d. duty paid.

Home Grown Sugars have been sold in considerable quantities and the prices to-day are 30s. 9d. to 31s. 3d. according to factory and quality.

The British refiners reduced their price on April 12th by 6d. per cwt. On April 20th they advanced them by 3d. and a further 3d. on April 21st, but on April 28th they were marked down 3d., and on May 2nd a further 6d. They were advanced again 3d. per cwt. on the 4th May. The latest prices are No. 1 Cubes 35s. 6d., London Granulated 31s. 10½d.

Raws have been more active and considerable business has been done to the British refiners at 13s. 10½d. and subsequently at 14s. 6¾d. and 14s. 9d. c.i.f. for May/July shipment. There are sellers to-day of June Cubans at 14s. 10½d.

In America there has been an improved demand for Refined and in consequence the refiners have been more anxious buyers of Raws. Cubans have been sold from $2\frac{7}{8}$ up to $3\frac{1}{16}$ at which price there are buyers to-day. The New York Futures Market has also recovered 15 to 20 points.

With regard to the European sowings, F. O. Licht has reduced his estimate of 2,378,500 hectares to 2,366,500. This is an increase including Russia of 11·92 per cent. over last year. The estimate of Dr. Mikusch is 11·13 per cent. increase.

The Cuban crop is rapidly nearing its conclusion and it is estimated that already 4,400,000 tons have been manufactured. The stocks at the ports are 1,449,624 tons against 1,452,146 tons last year, whilst the receipts to date are 2,967,211 tons against 3,204,121 last year.

21, Mincing Lane,
London, E.C. 3.
9th May, 1927.

Arthur B. Hodge,
Sugar Merchants and Brokers.

THE

INTERNATIONAL SUGAR JOURNAL.

☞ All communications to be addressed to "The International Sugar Journal," 2, St. Dunstan's Hill, London, E.C. 3.

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No. 342. JUNE, 1927. Vol. XXIX.

Notes and Comments.

The Empire Marketing Board.

The Rt. Hon. W. Ormsby-Gore, M.P. (Under-Secretary of State for the Colonies) recently delivered an instructive lecture under the auspices of the West India Committee to explain the aims and the work of the Empire Marketing Board. From the lengthy report in that Committee's *Circular*, we summarize the main points of the lecture below.

The Empire Marketing Board is an official but non-political body which was established in May of last year, following a recommendation of the Imperial Economic Committee to the effect that an "Executive Commission" should be formed "with the duty of conducting the movement for trade in Empire produce." The Board exists for this general purpose, but it is charged also with the duty of advising the Secretary of State for Dominion Affairs in the expenditure of an annual grant of £1,000,000 voted for the furtherance of the marketing in this country of Empire products, including home grown agricultural produce. Owing to this financial assistance from Parliament, the Board's work is controlled by the Secretary of State for Dominion Affairs, but otherwise the Board is entirely non-party in character, its members, and the members of its Committees, being drawn from all shades of political opinion, and consisting of men and women who are able to bring to its councils expert experience from Home and Overseas.

The actual work of the Board consists in the stimulation of an ideal of co-operation between the different parts of the Empire, and falls, broadly speaking, into two main divisions: on the one hand to bring home to every section of the community the significance of the Empire and its resources; on the other hand, to mobilize the forces of research, both economic and scientific, to assist in the better production, distribution, storage, and marketing of Empire goods. To carry out this dual object two main committees have been formed, a Publicity Committee, and a Research Committee. The members of these committees, it should be added, have given their invaluable services voluntarily to the Board.

The Publicity Committee is concerned with the advertising of the Empire to the public at large; but for obvious reasons it must exclude any specific advertising of particular goods. It aims instead at providing a general advertising background against which the more specific advertising of particular commodities can be thrown into relief and of which individual adver-

tisers can take advantage to push their particular products with maximum of effect. Accordingly the publicity takes the form mainly of calling attention, by means of display advertisements in the press and coloured posters on special hoardings, to the Empire and its resources, and thereby to familiarize the public with the range of Empire products which can be bought by them. Posters illustrating "Highways of Empire" have already been displayed as a start; and a regular series is being designed to be displayed at stated intervals, in all the large towns of the United Kingdom.

The other side of the Board's work, the Research side, is in the hands of a committee which is not itself a scientific body but a small lay committee which works through existing departments or institutions. In particular it considers applications for grants in aid of scientific research made by recognized institutions in the Empire or by new bodies which the Board deems worth inaugurating. Thus the Board has just put up a capital grant of £15,000 and an annual maintenance grant of £4,000 a year for five years, for the establishment of a sort of parasite zoo in this country, where beneficial parasites may be bred and distributed over the Empire as required to carry on war against insect enemies of Empire production. Grants are also to be made towards the cost of discovering weed parasites; a beginning has been made in an attempt to check the growth of the blackberry plant, an injurious pest of the farmer in New Zealand, and parasites of that plant are to be let loose in that Dominion in the hopes of destroying the weed in question.

The Empire Marketing Board also proposes establishing a chain of scientific research stations in tropical and sub-tropical parts of the Empire, and has already made substantial grants to the Trinidad College. Tropical research presents a host of problems of immense economic importance to the Empire, involving as it does the better production of a whole range of tropical plants on which we at home are dependent for our supplies. Even the United States, which spends on agricultural research more than twice as much as our whole Empire, has hardly yet begun to tackle comprehensively the problems of tropical agriculture, and we in England possess therefore a unique opportunity for pioneer work in this field of research.

We have quoted enough from the lecture of Mr. ORMSBY-GORE to show the far-reaching importance of this new move in the cause of Empire development. Amongst the tropical products that stand to gain greatly by this application of scientific methods, sugar should be a leading feature, and in time the disparity in economic production which undeniably exists as between the Java or Hawaii sugar industries, and that carried on in some parts of our Empire, should tend to disappear. As contrasted with Cuba, it is doubtful whether any Empire sugar producing region will find it practicable to run such large individual milling installations as exist in that island; but in respect to the technique of cane cultivation generally the Cuban standard is no high one and is easily surpassed.

A Central Federation for Empire Sugar.

While the Empire Marketing Board is taking steps to further the interests of tropical Empire produce, of which sugar is an important item, there are not lacking efforts on the part of private enterprise to pursue the same stimulative course. The British Empire Producers' Organization recently decided that its Sugar Section should be constituted into a Federation, the membership of which shall include the producers and refiners of the sugar industry and all others interested in the production, transport and marketing of Empire

sugar. The objects of the Federation are to promote the interests of the sugar industry of the Empire and to collect information in regard to all matters relating to methods of production, transport and marketing; to carry out a programme of propaganda and publicity with a view to increasing the production, sale and consumption of Empire sugar and to obtain such treatment for Empire-produced sugar as will secure stability and generally to take such action as may be considered desirable in the interests of the Empire sugar industry. This central organisation has been rendered necessary not only to improve the internal methods of the industry and to increase production within the Empire, but also to be able to confront as a united body, the highly organized competition of European and American producers and refiners. Mr. BEN H. MORGAN has been unanimously elected as Chairman of the new body. Mr. MORGAN, who has long been associated with Empire development, has for the past six years acted as Chairman of of the Council British Empire Producers' Organisation.

The 1927 Budget.

The Finance Bill of this year, as unfolded in the Budget resolutions of April, had after all no change in store for the sugar duties; these remain as hitherto at 11s. 8d. per cwt. for foreign refined and 7s. 4½d. for British overseas refined. The increasing hope that the Chancellor of the Exchequer would see his way to increasing the duty on foreign refined, so as to give Home Refined an advantage over its foreign competitors was doomed to disappointment. A good case could doubtless be made out for so assisting the home refiner who has up against him the surplus production of foreign sugar countries sent here at a price which often shows little if any profit; but the Government it they conceded this for sugar might find themselves pressed to do the same for a variety of other home manufactures subject to dumped foreign competition, and we should have the beginnings of a general tariff for which (however much the Government might at heart desire it) they have been refused an electoral mandate. At the same time Mr. CHURCHILL is not oblivious of the refiners' case, and if by next year he can solve the difficulty in some other way, it is just possible he may make some concession.

The Outlook in Cuba.

According to American consular advices, business in Cuba during the first four months of the year did not come up to expectations. The general confidence at the beginning of the year that sugar would average over 3 cents per lb. during 1927 was doomed to disappointment, as the average net figure dropped steadily, and the March figure was only about 2¾ cents. After that prices strengthened somewhat, and by the beginning of May the average for the year to date was 2·83 cents, which is two-thirds of a cent. per lb. better than Cuba averaged during the grinding season of 1926; or in other words some 32 million more dollars are available for Cuba's 40,000 colonos. It is expected that this increased remuneration will help the growers over the difficult period between the crops.

To add to Cuba's difficulties, the island has till the last few weeks suffered from a prolonged drought which has injured crops of all kinds, that of sugar not least. It is of course premature to attempt to estimate its effect on a crop that will not be reaped before next January; but the view has been expressed in Havana that if the present arrears are not regained the output next season, even if unrestricted, would not exceed 4,800,000 tons. Since the Cuban canefields have in a normal season a potential output of some 6 million tons of sugar, it seems a safe assumption that the effect of the

drought has not been negligible. Confirmation of this view is offered by LAMBORN who report from reliable sources that the rainfall during the first three months of the year has been the lowest in 20 years, barring 1907 the year following the 1906 cyclone. The crop in 1907 was 1,400,000 tons, and that in 1908 only 961,958 tons on account of the 1907 drought.

Cuban Trading Conditions in 1926.

The foreign trade returns of Cuba for the year 1926 show a considerable recession in the value of the exports, which is a reflection of the persistent low prices for sugar experienced that year; and the resultant loss of purchasing power was responsible for a proportionate cutting down of imports. The exports fell from 354 million dollars in 1925 to 302 million dollars in 1926, a drop of about 15 per cent. Imports declined from 297 millions to 261 millions, a loss of 12 per cent. In 1925 Cuban imports from the U.S.A. comprised 63 per cent. of the total, but in 1926 they had fallen to 61·5 per cent. The only countries that sold more to Cuba during 1926 were France, with an increase of 5 per cent., and the United Kingdom with a relative gain of about the same figure.

The most striking feature of Cuba's 1926 export trade was the 60 per cent. decline in sales to the United Kingdom. That country purchased only about 22 million dollars worth of Cuban goods, as against 55 millions the year before. This drop resulted from the greatly diminished purchases of Cuban sugar, as well as the lower prices paid for that commodity. The purchases of the United States dropped by about 8 per cent. ($21,000,000), but amounted to some 242 million dollars. As against this, Cuba's imports from the States decreased by over 27 million dollars. Finally, that proportion of Cuba's exports destined for the United States was 80 per cent. in 1926, as compared with 75 per cent. in 1925; while that to the United Kingdom fell from 15 per cent. in 1925 to less than 8 per cent. in 1926.

The American Floods.

The catastrophe which has recently visited the central southern states of the U.S.A. through the overflowing of the waters of the Mississippi is of unprecedented severity and has caused widespread disaster to property, though fortunately it has not resulted in much loss of life. This great American river has a catchment basin about 2000 miles wide—from the Alleghanies to the Rocky Mountains—and fully a thousand miles long, and it is fed by tributaries which are in themselves great rivers. In the course of its leisurely flow to the sea in the Gulf of New Orleans it traverses vast plains whose level is very little higher than that of the river. In fact, the margin is too small to allow for exceptional flood heights, and consequently embankments (*levees*, as they are called locally) have in the past had to be erected all along the banks to save the surrounding country from being flooded. But the river in course of time has permanently raised its bed through silting, so that the level of the water has gradually risen; and once exceptional conditions occur (which seems to have been the case this year when the watershed has encountered exceptionally rainy weather) the rise of the river has been too much for the levees and these have been breached wholesale, with the result that a flood of anything up to 15 feet deep has been let loose on the surrounding agricultural country and even on some of the river towns. New Orleans has narrowly escaped disaster, being only saved by the sacrifice of a large tract of country which was purposely flooded to provide an extra outlet to the sea. The well-known Louisiana "Sugar Bowl," a fertile tract lying in the angle

between the Red River and the Mississippi, for some weeks succeeded in averting the flood, and it was thought that it would be saved. But the Red River towards the end of May brought down more flood water, and this breached the embankments in various places for some fifty miles, with the result that most if not all of the sugar cane country has been heavily flooded. At the time of writing any complete account of the damage is not available, and one has to depend on the brief telegraphic dispatches which have reached this country. Later accounts suggest that the most easterly section of the tract has escaped complete flooding. But the bulk of the sugar crop, estimated at about 60,000 tons, would seem to have been destroyed.

More serious. perhaps, from the point of view of the revival of the Louisiana sugar industry is the fate of some 22,000 acres of Java P.O.J. cane which had been grown to supply cane sets for the industry generally, in accordance with a settled policy of substituting Java canes for the existing degenerate local canes. This nursery crop was lately described as a remarkable stand, and great hopes were built up on its distribution to farmers over the "sugar bowl." There is no definite news as to whether it has been destroyed or not, but we fear it can hardly have escaped the fate which has overtaken most of the other sugar lands. If it has gone, then a severe blow has been dealt to the Louisiana sugar industry just when the way seemed open to some marked improvement on its agricultural side. The flooding appears to have been confined to the west bank of the Mississippi, so it is conceivable that Baton Rouge with all its educational facilities and its experimental field work, lying on the eastern bank as it does, may have escaped the flood damage. We sincerely trust this may prove the case.

The Louisiana sugar crop affected is reported to have been only a 60,000 ton one, so the effect of the disaster on the world's sugar market has been comparatively slight. But its effect on the fortunes of Louisiana as a sugar growing region may conceivably be more serious. This industry has been under a cloud as it were for many years, and the calling in last year of experts to overhaul it from top to bottom was a last attempt to resuscitate an industry which has not been remarkable for vitality and technical development, especially on the agricultural side. Now with the wiping out of the plantations and planters' homesteads it is to be feared that many discouraged cultivators will either migrate elsewhere or will turn to other crops. But the sugar industry is only one amongst several which has suffered overwhelming disaster through these abnormal floods, and taken as a whole the disaster will be a serious setback to industry in what is one of the most fertile parts of the United States.

The Japanese Firm of Suzuki & Co.

Early in April, the firm of Suzuki & Co., of Tokio, one of the largest commercial houses in Japan, and one of the two principal dealers in sugar in that country, got into difficulties and had to suspend payment. Troubles due to a succession of earthquakes since 1923 and to big operations in sugar have come to a head of late, but the culminating cause was undoubtedly the withdrawal of the support of the Formosa Bank which having lent the Suzuki Company a large amount (said by a correspondent of the *Times* to be no less than £35,000,000) had to refuse any further credit owing to difficulties of its own. The magnitude of the business conducted by the Suzuki firm was such that though its difficulties had long been public knowledge, it was not expected that it would be allowed to go under. Desperate efforts were made to secure support from other sources, but without success;

and as the Formosa Bank itself got into difficulties, it had no option but to refuse further facilities. As a matter of fact the severe earthquakes which have occurred in Japan since 1923 have put the whole Japanese banking world in a tight corner; and just about the time of the Suzuki failure some 30 banks suspended payment, and the Government had to resolve on a three weeks' moratorium to give them time to re-organize their finances. The immediate effect of these suspensions, not only of the banks but of so big a firm as Messrs. Suzuki, has been very unsettling to industry in Japan, and all business is sadly limited with the exception of that in raw silk. And repercussion on the world's sugar markets has not been lacking, as a good deal of selling by nervous speculators was a consequence of the Suzuki failure.

A Calcutta paper[1] publishes some interesting notes on the rise and progress of the Suzuki business, which it deems one of the romances of the commercial world. Twenty-six years ago the business was a comparatively small affair, and was confined to sugar refining. Then Mr. SUZUKI died, and his widow, in defiance of Japanese social customs, herself proceeded to carry on the business he had left behind. She sold the sugar refinery for £600,000, and with the capital thus secured started on a series of transactions that brought her fame and fortune. Largely operating through subsidiary companies, her firm now owns large estates in Japan, Korea and the West Indies; it has huge interests not only in sugar but also in mines, steel works, cotton and flour mills, breweries, banks, and insurance companies, and a monopoly of the production of crude camphor. The business has offices in some of the principal cities of the world. These wide ramifications brought Madame SUZUKI huge profits during the war; in particular it is said her speculations in rice brought about a rise in prices that led to the public showing its resentment by burning down her offices. But the business felt the full force of economic reaction in Japan in 1920, and since then the succession of earthquakes (that of 1923 did damage to Japanese industry to the extent of £186,000,000) has dealt it a blow which has culminated in its recent failure. With so vast a trading organization at its command, it may, however, be assumed that it will not be long ere Suzuki & Co. are once more in active operation.

An International Association for Sugar Statistics in Europe.

An International sugar conference of delegates of the sugar industry of Germany, Czecho-slovakia, Hungary, Poland, Belgium, Italy, the Irish Free State, Jugo-slavia, Rumania and Austria was held on May 23rd in Vienna, the president of the Central Association of the Czechoslovak Sugar Industry, Mr. CRON, presiding. At this conference it was decided to re-establish the International Association for sugar statistics, which was in existence before the War, and to build up the organization on a larger basis. The sugar industries of Sweden, Finland and Latvia informed the conference of their inability to send delegates, but the foundation of the Association was heartily welcomed by them. The French sugar industry also expressed regret at not being able to send a delegate on the date on which the conference was to be held. The object of the International Association for Sugar Statistics will be to procure reliable data on the beet acreage and the presumable quantity of beets manufactured and sugar produced in Europe, and to make these data known to the public. Dr. GUSTAV MIKUSCH, the sugar statistician of Vienna, has been entrusted with the management of the Association.

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[1] *Commerce*, 14th May, 1927.

British Beet Sugar Notes.

At the statutory first general meeting of the Lincolnshire Beet Sugar Company, which is erecting a factory at Bardney (on the river Witham, a few miles east of Lincoln), it was stated that the whole of the 325,000 preference shares recently offered had been allotted, though a rather large amount was to the underwriters. The factory buildings are advancing very rapidly, and are likely to be ready before the contract time, thus ensuring their starting the coming campaign in good time. As for the supply of beets, the company have arranged contracts with some 2780 growers for a total of 11,400 acres. The immediate prospects of this factory are therefore very satisfactory. It may be added that this is a Dyer-designed establishment.

Good progress is being made with the new Shropshire beet sugar factory that is being erected at Allscott, near Wellington, and it is expected to be ready for work during October. This is being started by the Shropshire Beet Sugar Co. Ltd., of which Viscount LEWISHAM is Chairman, and the capital is £373,000. This factory is not (as we stated in error in our April issue) to be a duplicate of the Dyer-designed factory at Peterborough. The Erste Brünner Maschinenfabriks-Gesellschaft of Brün are responsible for its design, and the principal contractors are Messrs. Perry & Co. (Bow) Ltd., of London, working in conjunction with Messrs. Fraser & Chalmers Engineering Works, Erith. The capacity of this plant is expected to be 800 to 1000 tons of beet per 24 hours. The factory is designed to work on a pressure evaporation system and with ordinary diffusion, while the product is to be white granulated. For the beet handling a wagon tipping and conveyor system is to be adopted instead of the more usual flumes. Special attention is being given in the design, we understand, to secure the best recent methods of treating the factory effluents.

Apart from Bardney, there would appear to be an attempt to erect before long a factory in north Lincolnshire in the Brigg district. Over 6000 acres have been promised so far, and if 10,000 can be secured steps will in all probability be taken to have a factory for that area also.

Another district that is taking definite steps to have a factory is Bedfordshire, a company having just recently been registered under the chairmanship of Sir H. TRUSTAM EVE to carry out the scheme, which is being backed by the Beds. and Hunts. Farmers' Union. The proposed site is near Blunham and close to the Great Ouse.

Of other projects, the plans for a factory near Chichester have had to be abandoned this year, but 1928 is likely to see a factory erected in time for the 1928-29 crop. The Eynsham Beet Sugar Co. has been formed to erect a factory at Eynsham, Oxfordshire, but the outlook for a beet crop in that county is not at the moment particularly good, and there are experts who favour Oxford itself as the best site for a factory serving Oxfordshire, Berkshire and Buckinghamshire. Continued attempts are being made to work up a sufficient acreage of roots in Somerset and Devonshire to justify a factory in that part of the West of England. The depressing condition of British agriculture generally is likely to prove some incentive to farmers to take up the more profitable beetroot culture, where they have not already essayed the experiment.

According to the latest official figures, the total quantity of Home Grown beet sugar manufactured in the United Kingdom during the 1926-27 season upon which subsidy has been paid amounts to 151,538 tons.

The Beet Sugar Industry in the United Kingdom.

Ministry of Agriculture Report for 1926-27.

The following account of the agricultural operations relating to the beet sugar industry in the United Kingdom during last season is taken from the official Agricultural Statistics of the Ministry of Agriculture and Fisheries for the year 1926.[1]

The acreage under sugar beet showed a further important increase in 1926, and was more than double that of 1925, the area being 125,814 acres as compared with 54,750 acres, an increase of 71,064 acres. The growing of this crop is concentrated largely in East Anglia and the East Midlands, where the factories are most numerous, and Norfolk still continues to lead, with 32,384 acres, or 25·7 per cent. of the total acreage in the country in 1926, Suffolk coming next with 25,000 acres. There was a noticeable increase in the acreage in Lincolnshire from 7189 acres in 1925 to 16,320 acres in 1926, and in Yorkshire from 2285 acres to 5088 acres, owing, no doubt in both cases, to the erection of factories—at Poppleton (near York), Spalding and Peterborough.

The number of beet sugar factories in England and Wales increased from three in 1924 and eight in 1925, to 12 in 1926. The three new factories erected in 1926 are situated at Felstead (Essex), Poppleton (near York), and Peterborough. The Spalding factory, which was completed in 1925, but did not work owing to difficulty in obtaining an adequate supply of water, worked a full season in 1926. Three new factories will be erected in time to deal with the 1927 crop.

The general increase in acreage under beet in 1926 was, however, due as much to the efforts of existing factories to obtain sufficient beets to enable them to approach their maximum capacity as to the erection of new factories. It will be seen from the accompanying table that whilst many factories in 1925 had insufficient supplies of beet, in 1926 this deficiency was in most cases made good. The increase, indeed, has been so encouraging that the factories at Spalding, Kidderminster and Felstead propose to double their capacity in 1927.

The returns of the tonnage dealt with at the factories in the 1926-27 manufacturing season are not yet complete, but the average yield per acre in 1926 of washed and topped roots is about 8·76 tons. This shows an increase of nearly one ton over that of 1925, which was 7·8 tons as compared with 8·2 tons per acre in 1924. The decrease in the yield per acre in 1925 may be attributed partly to the large numbers of growers in that year new to the crop, and partly to the severe weather at the time of lifting. Two of the factories in 1925 made a very late start through difficulty in the completion of the installation of plant and machinery, and deliveries of beets were unavoidably held up.

In 1926, on the other hand, the weather was very favourable for the greater part of harvest, and farmers were thus enabled to lift their roots without seriously interfering with their ordinary farm routine. Dry weather in September and October ripened the beets and they were harvested with less expense and delivered to the factory with a smaller proportion of tare than in 1925. The average tare over the whole 1926 season was about 15 lb. per cwt., with a range of 11·3 lb. to 20 lb. per cwt.

The spell of fine weather in September and October had, however, one consequence not quite so fortunate, as farmers, in their anxiety to complete

[1] *Agricultural Statistics*, 1926, Vol. lxi.

the harvest before wet weather set in, were tempted to deliver more than their quota in the early months of the manufacturing campaign. So much was this the case that supplies were delivered at the factories at a greater rate than they could be dealt with. This occasioned serious congestion, not only on the factory premises but also on the railways.

Factory.	Beet capacity in tons per campaign of 100 days.	Tons of Washed and Topped beets worked. 1925-26 Campaign.	1926-27 Campaign.
Working in 1925 :—			
Cantley	150,000	127,319	194,558
Kelham	75,000	32,203	81,014
Ely	150,000	80,179	171,358
Ipswich	120,000	21,088	139,242
Colwick	100,000	65,636	84,000
Kidderminster	50,000	28,873	54,818
Bury St. Edmunds	100,000	46,275	128,500
Wissington	60,000	26,640	45,457
Total	805,000	428,213	898,947
Additional Factories working in 1926 :—			
Poppleton (York)	100,000	—	54,702
Spalding	50,000	—	50,781
Felstead	50,000	—	32,635
Peterborough	70,000	—	61,640
Beet produced in England but manufactured in Scotland	—	—	3,559
Grand Total	1,075,000	428,213	1,102,264

In general, the weather of 1926 seems to have been more favourable for the growth of the crop than that of 1925, though it is stated in some quarters that the dry weather in August, September and October adversely affected the yield, although the sugar content was left unaffected. Complete returns of the analyses of the sugar content of the beets at the factories are not yet available, but from such estimates as have been received the averages in 1926 ranged from 15·8 to 17·7 per cent., compared with an average of 16·6 per cent. in 1924 and 16·36 in 1925.

Neither the tonnage per acre nor the sugar content of beets, taken separately, gives a reliable indication of the sugar output. It is only when these two factors are taken together and the amount of manufactured sugar produced per acre of beet under cultivation is arrived at, that a satisfactory test can be applied. The following statement shows the results of the 1924-25, 1925-26 and 1926-27 campaign set out in this form.

Season.	Acres.	No. of Factories.	Refined Sugar produced. cwts.	Production of White Sugar per acre of beet under cultivation. lbs.
1924-25	22,441	3	478,308	2,387
1925-26	54,750	8	1,032,759	2,113
1926-27	125,814	12	3,000,000*	2,671

* Estimated.

The average sugar production in the important Continental beet-growing countries appears to vary from approximately 2700 lb. to 3900 lb. of refined

sugar per acre. One explanation of the difference is to be found in the smaller yield per acre in this country (8¾ tons in 1926), whereas the Continental yields range from 10 to 13¼ tons per acre.

For one-year contracts the miminum price—based on a sugar content of 15½ per cent.—paid for beets in 1926 was slightly more favourable than in 1925, being 49s. a ton delivered factory, as compared with 44s. a ton. The prices for three-year contracts remained at 54s. a ton. The average prices actually paid by the factories for their beets were 52s. 4d. in 1924, 55s. 6d. in 1925, and about 59s. 3d. in 1926, with a range of 54s. 9d. to 61s. 11d. a ton. In 1927 the minimum price on one-year beet contracts has been increased to 51s. per ton.

Sugar Beet Cultivation.

A series of lectures on "Sugar Beet from Field to Factory," organized by the West Suffolk Agricultural Committee and the Bury and District Branch of the National Farmers' Union, was recently given at the Town Hall, Bury, Mr. R. BILSLAND presiding. The more salient points of the several papers are here given.

Mr. ARTHUR SYMONDS, dealing with the preparation of the ground up to seeding, said he had been specially interested in an American report on the working of the root itself. In the rich porous soil often irrigated in the U.S.A. it was found that the tap root went down 6 ft., and, in some cases, 7 ft. The report showed the fibroid roots and rootlets extended so that the beet had roots in column of earth 6 ft. in diam., and this meant that they crossed the neighbouring root and went beyond them. Where the land was badly cultivated, cloddy and ill-tilled, the lateral roots developed below 14 ins. from the surface, and then sought for nutrient. On well-tilled land they were found principally on the top soil, and, under these conditions, there was not a cub. cm. of soil 14 ins. from the surface which had not a root from the beet plant in it, excepting in the top half-inch. If this were so, good even tillage is particularly important; and, while the soil might not get too compact for corn, without a certain amount of care the soil became tighter than was good for the beet plant. A sugar beet root was soft, and could not easily develop where it was squeezed. Personally, the lecturer usually ploughed deep in the autumn, and if farmyard manure were being used it should be applied before the ploughing. If the tap root could get down 3 ft. it might be sufficiently deep for this country, but if the sub-soil were very compact, it should be broken to give the tap root a chance. In the Spring he usually ploughed again, but he did not say it was invariably right to plough the second time. Most farmers liked the root crop to be the rotation for cleaning the land, and if such fields were to be planted, it was far cheaper to clean the land before drilling. The proper date for drilling, to get weight and sugar content, was about the third week in April, but a grower who wanted to plant both early and late could begin as early in April as he liked. In such cases it was well to select a warm piece of land, because the plants would stand cold Spring weather better on warm land. The heavier land should not be left to the last, however, and if one must drill late it was best to leave a nice piece of mixed soil land, because plants would go ahead faster on this than on heavier land, and make up a bit for lost time.

The climate for sugar beet in East Anglia was incomparable, and the humid atmosphere and more temperate sunshine to some extent counter-

balanced the Continental advantage of richer soil. The fierce summer sun abroad had a tendency to evaporate all the moisture in the soil where it was not covered with vegetation, and this was where sugar beet tops were valuable. He was inclined to set his drill wider every year, bearing in mind the American object lesson of the action of the rootlets, and also the lesser evaporation conditions which might be expected in this country. It was not so easy to get a good plant on the ridge. Greater care was necessary to preserve the moisture in the soil to ensure a full plant, and rather more consideration was needed to cultivate the land, in both dry and wet weather, before the planting, in order to preserve and maintain the moulds that were conditioned by the winter frosts.

Mr. A. Amos, of the Cambridge University Experimental Farm, dealing with manuring and drilling, said that dung should be applied to the land in the winter, and the ground should be ploughed early. Some phosphates were required, and would repay application. Phosphates stimulated root growth as well as other parts of the plant. One cwt. to 1½ cwts. of potash per acre, if they applied dung to the land, would give an increase. As to top dressing, it was quite easy to overdo the application of nitrogen for the beet crop; on the other hand, if it were poor land, any manure would give a better return. The nitrogen factor was one that had got to be studied with a considerable amount of discretion. Another point to be remembered was that a free nitrogen supply would delay ripening, and it was therefore necessary not to overdo with nitrogen beet to be lifted early. He agreed with cleaning the land in the autumn, as stubble cleaning helps the beet crop. He urged the use of good seed and plenty of it. There was nothing more important than accurate drilling. The distance of the rows apart was a matter on which they wanted much more information, but he quoted figures derived from researches which favoured the wide rows. They should horse-hoe as early as possible, and they should set out as soon as they possibly could—as soon as the second pair of leaves had developed. On one of the crops at the University Farm they lifted some roots at intervals of a week from the middle of August until the end of October to get an idea of the weight per acre on the one hand and the sugar percentage on the other. Taking the percentages on the dry gravel, on August 18th, they had 18 per cent.; 25th, 19·3; September 1st, 21·1. Then came a wet week, and the percentage dropped to 16·5. It rose again to 17·2, 17·7, 18·8, and 18·8 on October 21st. These figures all bore on the early delivery of beet.

One of the problems now undergoing investigation, particularly in Norfolk and in other counties, is whether ridge or flat work is profitable. It was shewn last year that yield per acre was easily maintained on the ridge, but the sugar content was rather lower. Where the crowns were covered by running a little soil up late in the season, there was no difference in the sugar content. The difficulties with beet on the ridge are practical ones before and at the time of drilling the seed, and it is generally held that close work is essential. The evidence of Continental growers is overwhelming in this respect, but in the practice of close work with British labour there are always distinct chances that horses' feet and horse hoe blades find their way into the rows and gap the plant where it is not needed. Whether ridging would avoid this is not certain, but if ridging is to be successfully practised it would appear that close ridging is desirable.

The efficiency of sugar beet on the ridge turns upon a comparison of the extra cost of putting the seed into the ground and the probable smaller cost

of hoeing and singling the crop. It is well to remember that the latter is one of the rush periods in sugar beet growing and is a time when the work must be done at the right time or serious loss in crop may result. The advantages of roots on the ridge are well understood in Norfolk, but with sugar beet the new problem of ridging at close distances is presented. It should be capable of practical solution. There is some significance in the fact that there is a general tendency to widen the distance between the rows as experience with the crop grows. This must lead to a smaller yield, and it is just possible that satisfactory methods of ridging may help the work at 18 to 20 inches and avoid the grave danger of loss of plant during hoeing at these distances on the flat. If at the same time the cost of hoeing and singling could be lessened, ridging for sugar beet would soon become an established practice, for yield per acre and sugar content with care can be just as high on the ridge as on the flat. The difficulties at present are close ridging, and drilling on ridges close enough together to maintain the yield per acre.

Anachronisms in India.

By NOËL DEERR

The photographs reproduced opposite represent two very primitive types of mills still in actual operation in India. Fig. 1 shows the Kohlu or pestle and mortar type of mill. The mortar is formed from the base of a palm tree, the pestle being a long pole shod with iron. Motive power is supplied by the blindfolded bullock, additional weight being supplied by the driver who sits on the end of a lever. The juice flows out through a hole in the bottom of the mortar which communicates with a horizontal channel bored through the stump of the tree.

On the right of the mill may be seen the product—gur—in this case moulded into the form of a mill stone and hence known as charki gur. Indifferently the gur may be made into balls when it is known as bheli gur or into a semi-spherical shape when it is called nagori or kettledrum gur. Behind the mill and in the shed may be seen the mouth of the furnace over which the juice is boiled down to gur. This photograph was taken at Siswa Bazaar in the district of Gorakpore, not far from the Nepal border.

Fig. 2 shows the Bhelna or wooden roller mill consisting of two horizontal wooden rollers, motion to which is provided by the pin wheels operated by the bullocks. This mechanical power is the same as is still used in the Persian water wheel and it is curious to note that the identical device is represented by Père Labat as standard practice in the seventeenth century in the French West Indies. Here, however, iron was employed in the gears and wind or water formed the motive power.

The mill whence this photograph was taken was operating in the Punjab. Not many of these very primitive types of mills now exist in India but tens of thousands of country-made iron mills with rollers about 8 in. × 6 in. are in operation.

At the other end of the scale are to be found some eighteen modern factories of recent construction and design. The majority of these are equipped with eleven rollers, but there are four factories with fourteen rollers and at least one with a train of seventeen rollers.

Anachronisms in India.

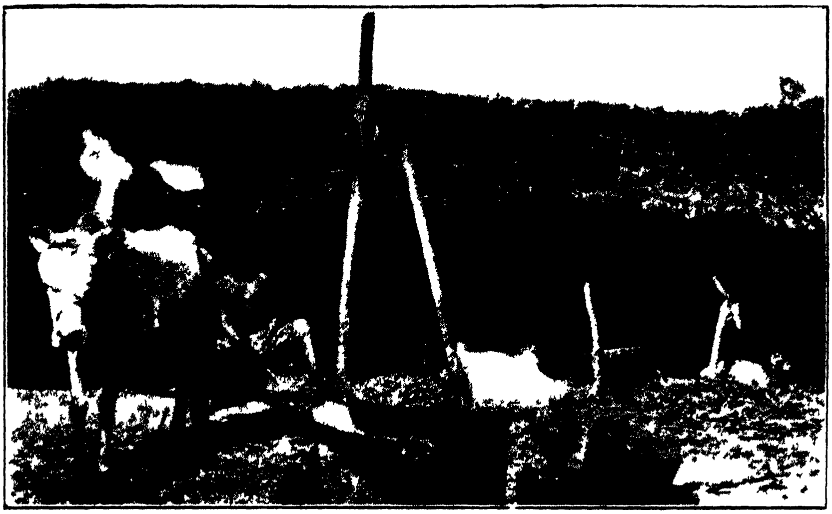


FIG 1

The Kohlu or Pestle and Mortar type of Mill

FIG. 2.

Bhelna or wooden roller Mill

Mealybug affecting Sugar Cane in Cuba.

FIG. 1.

Grass Root Mealybugs clinging to the roots of sugar cane.

FIG. 2.

Sugar Cane Stalk Mealybugs on node of sugar cane after leaf sheath has been removed.

FIG. 3.

Sugar Cane Stalk Mealybugs clustered about the base of young cane stalks.

A Preliminary Report on a Grass-root Mealybug (*Ripersia radicicola* Morrison) affecting Sugar Cane in Cuba.[1]

By C. F. STAHL.

During the past two years considerable interest has been manifested in a mealybug found feeding upon the roots of sugar cane in several localities in Cuba. This interest has been intensified by the fact that the insect was reported as undescribed, which led some to believe that it was a pest recently introduced into Cuba. An effort has been made to obtain as much information concerning this insect as other work in progress would allow. The purpose of this paper is to summarize these observations and to discuss certain points that they raise.

" Mealybug " and " chinche harinosa " are terms familiar to all who have had experience in growing sugar cane. Besides the mealybug under discussion, which occurs on the roots of grasses and sugar cane, two species of stalk mealybugs have been encountered in Cuba. They are widely distributed. They are red or grey soft-bodied insects, covered with a white powdery or fluffy substance, occurring in clusters, usually at the nodes under the leaf-sheaths of the cane stalks. It is the white powdery covering that is responsible for the common names " mealybug " and " chinche harinosa."

While the general appearance of mealybugs feeding on a plant is such that they may be easily recognized as a group, it is not so easy to distinguish between the different species. The common stalk forms may be found on the cane from the time it starts to germinate, and they are often seen beneath the surface of the ground, clustered around a germinating bud, or at the base of growing stalks. It would not, therefore, be surprising if another species feeding on the roots was thought to be identical with the stalk species and if the fact that this other species constituted a potential pest had been entirely overlooked. Such seems to have been the case.

No reference to the occurrence of a root-feeding mealybug on sugar cane in Cuba has been found in the available published reports prior to 1924. However, mealybugs were observed on the roots of sugar cane growing at Central Stewart in 1916 by Mr. J. T. CRAWLEY, who was at that time director of the Agricultural Experiment Station at Santiago de las Vegas. As this observation was never published, Mr. CRAWLEY has kindly furnished his notes, which are quoted as follows :—

" October 3rd, 1916. Fields are very uneven and there are many spots near the roads that are not thriving. Numbers of mealybugs, comejens and beetle grubs were found at the roots of cane. Easy to pull up. Probably 5 to 10 per cent. of the old fields so affected. Mealybugs are most abundant, both on the cane and at the roots of cane examined." Mr. CRAWLEY stated that he could remember that the mealybugs in question were often noted on the smaller roots, but he did not attach any particular significance to the fact at that time. It is very probable, in the light of what is now known concerning the distribution of the grass-root mealybug, that Mr. CRAWLEY observed this insect at that time. It can therefore be stated with reasonable certainty that the root-feeding mealybug was present on the roots of sugar cane in some districts of Cuba as early as 1916.

[1] Scientific Contributions No. 8, Tropical Plant Research Foundation. From the Cuba Sugar Club Experiment Station, Central Baraguá, Cuba. (Here abridged.)

In October, 1924, attention was called to a mealybug designated as *Ripersia* sp.[2] which was found infesting the roots of sugar cane in Cuba. BALLOU,[3] in his list of scale insects and mealybugs of Cuba, published in April, 1926, includes *Ripersia* sp. as having been collected at Camagüey by BRUNER in 1923. VAN DINE[4] records *Ripersia* sp. in his list of sugar cane insects and mentions its occurrence on the roots of numerous grasses in the Provinces of Oriente and Camagüey. MYERS[5] also mentions *Ripersia* sp. as having been observed at Soledad in Santa Clara Province. Finally, in October, 1926, MORRISON[6] published a description of the species under the name *Ripersia radicicola* n. sp., basing his description on material submitted from the Provinces of Oriente, Camagüey, and Santa Clara.

The tendency at first was to refer to this insect as "the sugar cane root mealybug," a name which would indicate that sugar cane was of primary importance as its host plant. As will be shown later, this does not seem to be the case. The common name "grass-root mealybug" is suggested because of the importance of wild grasses as host plants.

If this root mealybug limited its feeding to the roots of sugar cane, or even showed a preference for them, it might appear to be a pest which had been introduced in some way as a result of the extension of cane planting. It has been repeatedly observed that many different species of grasses are infested, and in many cases it is evident that the infestation is in no way related to the planting of sugar cane. In fact, infestations have been noted on the roots of grasses growing adjacent to cane fields in which the roots of cane stools were found upon examination to be uninfested. In a few cases mealybugs have been found on grasses growing in areas far removed from cane fields.

On the basis of these observations it is reasonable to assume that the root mealybug is a typical grass-root feeding species, that it is probably native or at least that it has been present in Cuba for a long time, and that under changing cultural conditions, brought about by the rapid extension of cane plantings, it has spread to the roots of sugar cane.

The distribution of the grass-root mealybug over the Island has not been fully determined. It was first noted by the writer on the roots of grasses and sugar cane growing on the plantation of Ingenio Jobabo. The infestations there were limited to areas where the soil was comparatively light and well drained. Records were made of infestations on the roots of grasses growing on ditch banks, in guardarrayas, along the edges of cane fields, and, in some cases, well within the cane fields. When the infestations were found on the roots of sugar cane, their location often indicated that the source might have been the adjacent guardarrayas, inasmuch as the areas infested were usually small semi-circular patches spreading from the edges of the fields. This was especially true where the guardarrayas had been planted to sweet potatoes (boniatos) and the natural grass hosts had in this way been suppressed. Later, more widespread infestations were found in the Province of Camagüey. [Then follow detailed lists of the localities in Cuba where the grass-root mealybug has been found, and of the grasses on which it was collected.]

[2] CALVINO, M. 1924. Combating the mealybug. *Facts about Sugar* 19, 354, 355.
[3] BALLOU, C. H. 1926. Los coccidos de Cuba y sus plantas hospederas. Cuba Estac. Expt. Agron. Bol. 51, 47 p.
[4] VAN DINE, D. L. 1926. A list of the insects affecting sugar cane in Cuba. Trop. Plant Research Found. Bul. 8, 16 p.
[5] MYERS, J. G. 1926. II. Dry-season studies of cane homoptera at Soledad, Cuba, with a list of the coccids of the district. Harvard Inst. Trop. Biol. and Med. Contrib. 3, p. 69-110, illus.
[6] MORRISON, H. 1926. An apparently new sugar-cane mealybug. *Jour. Agr. Research* 33 757-759, illus.

It should be noted that the majority of the grasses which have been found to be infested are annuals. This does not necessarily mean that the perennials are not host plants, but it indicates that the annual grasses are of primary importance as hosts. Roots of such grasses as paraná (*Panicum barbinode*) and Guinea grass (*Panicum maximum*) growing in infested areas have been examined many times, but the root mealybug has never been found on them.

It is not possible with the literature available to discuss in detail the relation between the grass-root mealybug and other root-inhabiting mealybugs. A number of reports have, however, been noted in which the occurrence of mealybugs on the roots of sugar cane and grasses in other countries has been mentioned. LEFROY[7] mentions *Ripersia sacchari* Cr. as living on cane as well as on rice and grasses in India but does not state that it is found on the roots. *Ripersia internodii* HALL, reported by WILLCOCKS[8] from Egypt, appears to be a species that feeds on grasses and sugar cane, both above and below the ground. It is, however, said to feed on the nodes and internodes of sugar cane. In the same report *Pseudococcus variabilis* Hall is mentioned as a common grass-root feeding species which is found well up on the jointed canes and around the nodes of sugar cane. *Pseudococcus trispinosus* Hall is also reported as feeding on the roots of sugar cane and grasses. From these scattered reports it will be seen that it is not uncommon to find the roots of grasses infested with mealybugs, as well as sugar cane.

As a rule it is not difficult to recognize the grass-root mealybug in the field. Perhaps the one species most apt to be confused with it is the grey sugar cane mealybug (*Pseudococcus boninsis* Kuwana). found commonly on the stalks of sugar cane in Cuba. This stalk mealybug may be distinguished from the root mealybug in several ways. It is somewhat larger, is covered with a more dense wax-like secretion, and is flatter. The root species is distinctly globular in shape, and the conspicuous pink tinge can be seen through the sparse powdery secretion. Perhaps, however, the best way to distinguish between the two species is by means of their feeding position on the plant. The stalk mealybug is usually found on the stalk above the ground, but when it is found below the surface of the ground it has always been in the crown at the base of the stalks or around the germinating buds (see Plate, Figs. 2 and 3). The root mealybug, on the other hand, has always been found on the roots and usually on the small rootlets, which spread out some distance from the base of the plant. The stalk species has not been found on grass, but it may be present on some of them, especially the large cultivated types. When a plant is pulled up some of the root mealybugs usually cling to the roots by means of their mouth parts, which they insert in the tissue of the roots (see Plate, Fig. 1).

There are other underground mealybugs which are commonly found on weeds and grasses in Cuba. A common weed, romerillo (*Bidens* sp.) is frequently found to be infested with mealybugs below the surface of the ground, and it has been reported that romerillo is responsible for the presence of the grass-root mealybugs in the cane fields. The species feeding on romerillo is found on the underground portion of the stems rather than on the roots, and it has not been found on the roots of sugar cane. Several

[7] MAXWELL-LEFROY, H. 1909. Indian insect life. A manual of the insects of the Plains. 786 p., illus. Calcutta, Simla (etc.)

[8] WILLCOCKS, F. C. 1925. The insect and related pests of Egypt. Volume II. Insects and mites feeding on gramineous crops and products in the field, granary, and mill. 418 p., illus. Cairo. (Sultan. Agr. Soc., Tech. Sect.)

grasses have been found to be infested in the crown by the romerillo species, which Dr. MORRISON has determined as *Pseudococcus virgatus* Ckll.

In common with other mealybugs, the grass-root mealybug is always attended by ants, which care for and protect them in return for a sweet substance known as honeydew secreted by the mealybugs.' The most common attending ant is a small, inconspicuous, almost black species, which has been determined by Dr. W. N. MANN of the United States Department of Agriculture as *Tapinoma melanocephalum* Fabr. This ant, whose nests have been found at the base of the infested plants, is very assiduous in its attentions, and when the mealybugs are disturbed will pick them up and scurry about in search of a hiding place for them. It is very probable that these ants are largely responsible for the spread of the mealybugs. In fact, plants grown in pots for experimental purposes have become infested in such a way as to show conclusively that the mealybugs had been placed on the roots by the ants. MYERS[9] reports a large ant (*Odontomachus haematoda insularis* Wheeler) in close association with the grass-root mealybug in the Soledad (Cienfuegos) area. Occasionally the fire ant, hormiga brava (*Solenopsis geminata* Fabr.), has been found associated with the grass-root mealybug, but the fire ant is more commonly found attending the stalk mealybugs.

There is some question in regard to the amount of injury that should be attributed to the grass-root mealybug. In areas of light soil, under drought conditions, this insect may cause severe injury to sugar cane. The damage is apparent where other factors, especially soil and drainage conditions, are unfavourable to the growth of the plant, In many cases the plants are killed in small areas. Under these conditions it has been almost impossible to obtain a new stand of cane. An uneven stand of cane has been observed in many Cuban fields, the vacant areas having grown up to grasses, which are often infested with root mealybugs. Grasses growing in these vacant areas perpetuate and augment the infestation, and consequently the areas become no longer suitable for growing cane. Unless the mealybugs are suppressed, or the grasses, or the conditions that favour their development are corrected, it is difficult to replant these areas. On the other hand, under favourable growing conditions, vigorous cane plants have been found to be heavily infested with root mealybugs. Often fields are found in which the plants are comparatively heavily infested but do not show any visible effect of the infestation. In other words, the area of injury from root mealybug does not coincide with the area of its distribution. It is probable, therefore, that the severe injury which follows a heavy infestation of the grass-root mealybug results from a number of unfavourable factors, of which the mealybug is only one.

The fact that so many grasses serve as hosts for the grass-root mealybug complicates the problem of control. Any expensive method of soil treatment would obviously be impractical if the importance of the presence of the grasses was overlooked. There is some evidence showing the relation of ants to the distribution of the mealybugs which would indicate that the reinfestation of treated areas will be a serious problem as long as there are grasses growing in the vicinity. In view of these considerations and until a more careful study has been made of all the factors concerned, soil fumigation does not seem likely to be a practical method of control.

The possibility of utilizing certain legumes for cover crops, as a means of improving the condition of the soil and suppressing the grasses in badly

[9] MYERS, J. G. 1926. II. Dry-season studies of cane homoptera at Soledad, Cuba, with a list of the coccids of the district. Harvard Inst. Trop. Biol. and Med. Contrib. 8, pp. 69-110, illus.

infested areas, has been considered. Certain legumes, such as sword and jack beans, make a rapid, dense growth which seems to be very effective in keeping down weeds and grasses. These beans are not host plants for the grass-root mealybug. Their value in farm practice as a means of soil improvement has long been recognized. A series of small plots has therefore been laid out in a heavily infested area where the injury is apparent. By means of these plots, observations may be made as to the efficiency of cover crops in suppressing the grass host plants of the mealybug and thus starving it out of the areas. The value of such crops as a means of correcting the poor soil condition can be determined, and also the growth habits of the beans under different seasonal conditions. It is hoped that observation of these plots may give suggestions which may later result in definite recommendations for the improvement of areas badly infested with mealybugs and lead to the discovery of practical control measures.

Determination of Sulphur Dioxide in Sugar Products.

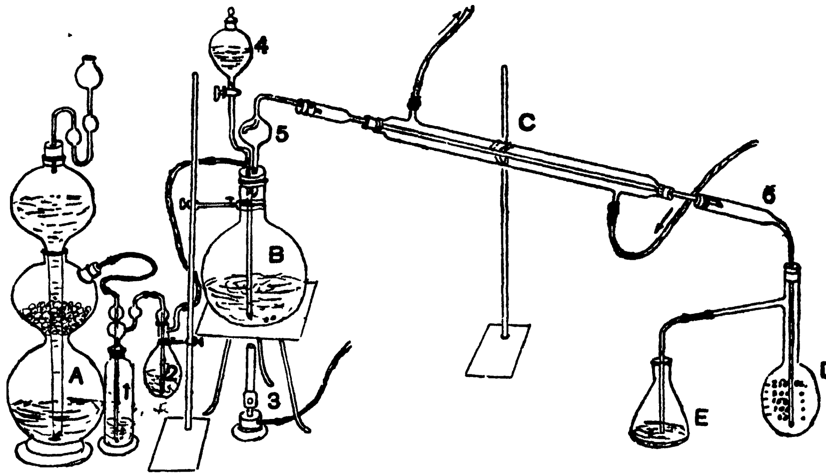
This subject arouses some attention in view of the new Public Health Regulation, which came into operation on January 1st of this year, according to which the total free and combined sulphur dioxide (SO_2) in sugars must not exceed 70 parts per million (or 0·007 per cent.).[1] Two useful contributions have appeared, the first by M. van de Kreke, Chemist to the Java Experiment Station[2] and the second by H. Drake-Law, D.Sc., F.I.C., a London consulting chemist.[3]

Results obtained by the Distillation Method.

In the first paper the so-called standard method was considered, that is, the distillation method, and in operating this the apparatus shown in the illustration reproduced herewith, and the details recently given by Ogilvie,[4] were followed. In flask *B* (having a capacity of 1500 c.c.) were placed 500 grms. of the sugar under examination, 500 c.c. of recently boiled water, and 10 c.c. of 25 per cent. phosphoric acid solution, together with a small piece or two of pumice stone. This flask was connected (as shown) on the one hand with a Kipp apparatus *A* generating carbon dioxide from marble, which gas passed through two wash-bottles 1 and 2, the first containing copper sulphate, and the second distilled water; and on the other hand with an ordinary Liebig condenser *C*, using a "splash-head" 5. A tap funnel 4 was made to enter the flask *B* by means of a 3-holed rubber stopper. This condenser was provided with an adapter 6, which dips into the receiving vessel *D*, composed of a distillation flask, the tubulure of which was connected with a bent tube dipping into a flask *E* containing water. In *D* were placed 50 c.c. of saturated bromine water, together with 5 c.c. of $N/5$ sulphuric acid solution. This latter was added, as it was expected that the sulphuric acid to be formed from the oxidation of the sulphite by the bromine water would be very small. Anyway, a blank determination was made later, working in the same way, without the addition of any sugar, and with the addition of the 5 c.c. of $N/5$ sulphuric acid. As for the flask *E* containing water, this was used simply to prevent bromine passing into the atmosphere of the room. During the whole of the distillation, in which heat was applied by means of bunsen 3, a slow current of CO_2 was conducted through the apparatus from the Kipp's generator *A*.

[1] *I.S.J.*, 1926, 644.
[2] *Archief*, 1927, 35, No. 14, 347-350.
[3] *Food Manufacture*, 1927, 1, No. 1, 21-22.
[4] *I.S.J.*, 1926, 646.

As soon as the volume of the distillate had reached about 200 c.c. (the flask being roughly calibrated to show the volume collected), boiling was discontinued, and the sulphuric acid in the distillate was determined gravimetrically as follows: After transfer to a large beaker, the distillate was boiled to eliminate from it the excess of bromine, its volume was again completed to 400 c.c., 5 c.c. of hydrochloric acid (1 : 3) added, the temperature raised to boiling point, and the sulphuric acid precipitated with 10 c.c. of boiling barium chloride solution (20 per cent.), the boiling being continued for about 10 mins. after the precipitation. After allowing the liquid to stand in a warm place, the precipitated barium sulphate was collected



on a small ashless filter-paper, dried, ignited in a platinum crucible, moistened with sulphuric acid, re-ignited, and cooled in a desiccator, and weighed. Then if a is the weight in grms. of barium sulphate obtained from 500 grms. of a sample of a sugar, and b is that obtained from the blank test (also including 5 c.c. of $N/5$ sulphuric acid), than the percentage of sulphur dioxide in the sugar is given by the formula: $(a - b)\ \frac{0{\cdot}27443}{5}$.

This procedure was applied (in duplicate) to a number of samples of *SHS* sugars from Java sulphitation and carbonation factories, the sugars of factories showing the largest difference in acidity between treated and untreated thick-juice (syrup) being chosen. But none of these gave a result exceeding the limit of 0·007 per cent., the highest being 0·0028 per cent., and the lowest 0·0006 per cent. Results of duplicate determinations agreed very closely, being in some cases identical.

CRITICISM OF METHODS OF DETERMINING SO_2.

The author of the second paper, however, critically examines the existing methods for the determination of sulphur dioxide in food products, including this distillation method, and states that they give "unreliable and inaccurate results." He describes first the so-called reduction method (the sulphide stain procedure, described recently[5]), and says of it that it is very simple and expeditious. "Results may be obtained rapidly, and several estimations can be carried out concurrently. The great disadvantage of the test is that it is not specific for sulphur dioxide, many other sulphur-containing compounds reacting in a similar manner. Its application has hitherto been

[5] *I.S.J.*, 1926, 647.

confined to the sugar and glucose industries, but the procedure should find a more extensive use if only as an eliminating test." Next he comments on the distillation method, which, as it is that generally applied, has therefore been subjected to the greatest amount of investigation. Modifications of this method depend on whether the distillate is collected in standard iodine ; or whether it is oxidized to sulphur trioxide, using some oxidizing agent, as bromine, hydrogen peroxide, etc., and the SO_3 precipitated as barium sulphate. In regard to this oxidation procedure, its disadvantage is that the reactions are not limited to sulphur dioxide, as other compounds may (and do) respond to a similar treatment. "No modification has yet been proposed which can be relied upon to give the degree of accuracy now required."

This author makes the following further statements regarding the accuracy of this determination : "Many recent investigations have been carried out to determine the relative accuracy of the various methods proposed. Certain fundamental difficulties have, however, been encountered. Sulphur dioxide reacts rapidly with many of the products with which it comes into contact, and causes an immediate loss of preservative. This is partly due to oxidation, but also to direct combination with the food material. The missing proportion of sulphur dioxide may or may not reappear under the action of the reagents used for its estimation. Certain foodstuffs show the presence of sulphur dioxide when none has actually been added. Others which originally gave no test for sulphur dioxide will, on standing, show appreciable amounts. It is therefore almost impossible to find a satisfactory method for estimating the small traces of sulphur dioxide which are now permitted in foodstuffs." A sample of caramel was examined by the distillation method ; (*a*) titrating the distillate with $N/100$ iodine solution ; and (*b*) precipitating it with barium chloride, the first procedure showing 140 parts of SO_2 per million, and the second indicating none, which latter was the correct result. Another sample gave 100 and 10 p.p.m. respectively, the high result with the iodine method being due to the presence in the caramel of volatile aldehydes and ketonic acids. In the case of a Mauritius sugar, determinations were made both by the reduction (sulphide stain) and the oxidation methods using sulphate precipitation, but in this instance the results agreed well, 100 p.p.m. of SO_2 being found. Iodine titration gave a 10 per cent. higher result. Various other products were examined, results obtained (*a*) by iodine titration and (*b*) by bromine oxidation and sulphate precipitation, being as follows : American flour, (*a*) 150, (*b*) 150 ; British flour, (*a*) none, (*b*) none ; Dutch cornflour, (*a*) 50, (*b*) 30 ; Sulphur dioxide was added to cooked meats, when an immediate loss of sulphur dioxide amounting in some cases to many hundredth parts per million was observed, this destruction continuing for several days, but never becoming stationary. Similar results were obtained with dried fruits, it being also found that the fibrous matter, even on being thoroughly minced, retained tenaciously a portion of the SO_2. It is concluded that : "The final evidence of these and other investigations points to the conclusion that it is rarely possible to estimate sulphur dioxide with a degree of accuracy within 50 parts per million, and frequently a greater margin is necessary. An entirely new and specific method of estimating this preservative is urgently required. It is obvious that any food manufacturer's products may be suspected of containing sulphur dioxide when none has been added. We need above all a standard and official method of analysis which will give at least equal results in the hands of all analysts, and which will be of assistance in preventing unjust prosecutions from taking place."

The 1926 Java Sugar Crop.

By R. J. PRINSEN GEERLIGS.

During 1926 178 factories were active in Java. The sugar estates planted and harvested an area of 179,702 hectares (444,038 acres) against 178,290 hectares (439,695 acres) in 1925. The total amount of cane harvested was 18,683,145 tons[1]) or 42·08 tons to the acre. The total sugar crop amounted to 1,941,649 tons or 9,782 lbs. to the acre. The figures for the different Residencies and the totals and averages in tons, lbs., acres, etc., as given below, are calculated after the data published by Mr. J. VAN HARREVELD in the *Archief voor de Java Suikerindustrie.*[2])

The 1926 season proved a disappointing one ; it had an average production of sugar to the acre of only 9,782 lbs., as compared with 11,491 lbs. in 1925.

The monthly estimates of the production of the mills, associated with the United Java Sugar Producers, which figures are expressed in piculs of 136·16 lbs., were as follows :—

Date.	Estimate. Piculs.	Date.	Estimate. Piculs.
26th March	29,951,282	31st August	29,438,801
30th April	30,071,465	30th September	29,297,772
31st May	29,929,879	31st October	29,387,319
30th June	29,841,962	Final result	29,394,324
31st July	29,666,909		

In 1926 the average tonnage of cane amounted to 42·08 tons to the acre. The Residency of Kedoe reported the largest figure (54·10 tons) followed by Banjoemas (49·36 tons), while Cheribon was lowest in this respect with only 36·78 tons of cane to the acre.

The sugar content of the cane was poor and gave an average sugar extraction of 10·38 per cent. The highest was attained in the Residency of Soerabaja with 10·65 and the lowest in that of Semarang with 9·33 per cent.

The highest average yield of sugar to the acre is reported from the Residency of Kedoe with 12·345 and the lowest in the Residency of Semarang with 7·842 lbs. The maximum figure for one single factory was witnessed in the Residency of Soerabaja, where Toelangan estate scored the greatest output of sugar to the acre with 16·578 lbs.

In studying the list of cane varieties planted it will be seen that there is not much divergence from previous distributions. EK 28 and DI 52 are again leading, B 247 is decreasing, while POJ canes are rapidly increasing. The distribution of other available sorts among the plantations remains comparatively unchanged.

The total sugar crop amounted to 1,941,649 tons, of which 1,890,544 tons were first sugars, and the balance consisted of after-products, calculated back to the equivalent of first runnings in ratio of 4 : 3. The figures in the second column of Table III refer, however, to the real weight. Besides the sugar, a quantity of 98,525 tons of solidified molasses was manufactured and exported.

Table IV shows an increase in the proportion of the first runnings white plantation sugar, and a decrease in the Channel assortment and in the refining crystals polarizing 96·5°. As the Japanese Government has now passed

[1] Tons of 2240 lbs.

[2] Mededeelingen van het Proefstation voor de Java Suikerindustrie, 1927, No. 1.

the new tariff Bill for sugar, on all their contracts bought with the option Head sugar or Muscovados the Japanese exporters have declared from the 1st of April, 1927 the classification of "Head sugar." It seems certain that during the present season practically no muscovados will be produced in Java.

The data now following, dealing with the figures for factory work, have been derived from the statistics annually issued by the Chemical Department of the Java Sugar Experimental Station; but whereas the foregoing figures referred to every one of the 178 factories, the technical data relate only to 168 establishments, viz., those subscribing to the upkeep of the station. As these are the best controlled factories, it is probable that the figures recording the work in them are better than the total average of the 178 that worked in 1926, although it is not believed that the difference is large.

In addition to the list of averages, we give here a few maxima and minima, relating to the results of the entire grinding season in the individual factories. We have not added the names, as these are unnecessary.

	Maximum.			Minimum.	
	1925.	1926.		1925.	1926.
Sucrose in Cane	16·20	15·00	..	11·90	10·60
Fibre in cane	17·90	18·10	..	10·20	9·50
Sucrose in bagasse	5·80	5·60	..	1·80	1·70
Moisture in bagasse	49·50	52·10	..	41·40	41·10
Sucrose in filter-press mud (defecation)	10·50	10·30	..	0·60	0·40
Sucrose in filter-press mud (carbonation)	3·20	3·10	..	0·10	0·20
Purity of raw juice	89·10	87·60	..	77·70	74·70
Purity of final molasses	35·60	34·70	..	23·80	23·0
Sucrose in juice on 100 cane	15·36	14·57	..	10·99	9·82
Calculated available sugar on 100 cane	15·14	14·01	..	10·19	8·75
Sugar extracted on 100 cane	14·99	13·63	..	10·05	8·67

The sugar content of the cane was poor, as was the case with the purity of the raw juice. Though the extraction of the juice by the mills was very satisfactory, the amount of sucrose extracted in juice on 100 cane (being 11·70 per cent. on an average) was very low. The same thing was also observed for the calculated available sugar, which was 10·87 per cent., of which actually 10·85 was extracted. The quotient of purity of the exhausted molasses was 30·00. In general, the work done in the sugar-house was very good, both in respect to the milling work and to the working up of the juice.

We also give below the data, relating to the total sales of Java sugars, and the portion sold by the United Java Sugar Producers, which body, according to these figures, disposed of 91 per cent. of the total Java crop of the year 1926.

Assortments.	Total Sales Piculs.		Sales by U.J.S.P. Piculs.
Superior "head" sugar	19,178,957	..	17,507,429
Superior soft sugar	168,699		168,351
Channel assortment, 98° pol.	5,514,372		4,845,948
Raw sugar, 96·5° pol	6,280,213		6,298,991
Molasses sugar	1,049,071		465,187
Bag sugar	52,703		45,127
Total Sales	32,244,015	..	29,331,033

All these figures represent piculs of 61·76 kg. or 136·16 lbs.

The United Java Sugar Producers began their sales of the 1926 crop in the month of March 1925, but up to the 1st of November they could not dispose of more than 1,049,916 piculs. After this date the market improved, so that by the 1st of January, 1926, 15,731,300 piculs were sold, and by the 1st of May, 25,221,186 piculs. On the 14th of October, 1926, all of the crop

I.—CANE CROP.

Residencies and Totals.	Number of Factories.	Land under Cane. Hectares.	Acres.	Cane Harvested. Tons.	Tons. per Acre.	Kg. per Hectare.
Cheribon	11	11,285	27,885	1,026,165	36·78	92,344
Pekalongan	17	17,353	42,879	1,852,163	43·19	108,446
Banjoemas	5	6,280	15,518	766,396	49·36	123,938
Kedoe	2	4,215	10,415	563,052	54·10	135,687
Djokdjakarta	17	16,500	40,771	1,856,850	45·55	114,364
Soerakarta	16	17,633	43,571	1,761,382	40·42	101,483
Semarang	11	10,345	25,562	958,937	37·50	94,172
Madioen	6	8,646	21,364	852,429	40·21	100,177
Kediri	21	24,835	61,366	2,414,216	39·34	98,785
Soerabaja	36	28,299	69,926	3,048,785	43·61	109,490
Pasoeroean	27	27,010	66,741	2,779,880	41·75	104,529
Besoekai	9	7,301	18,040	802,890	44·51	111,753
Total 1926	**178**	**179,702**	**444,038**	**18,683,145**	**42·08**	**105,660**
„ 1925	179	178,290	439,695	19,023,897	43·19	108,446
„ 1924	179	172,311	424,945	18,029,702	42·36	106,357
„ 1923	179	162,481	401,485	16,078,051	40·04	99,986
„ 1922	182	160,908	397,443	16,759,106	42·05	105,816
„ 1921	183	159,474	394,060	14,939,679	37·89	95,125
„ 1920	183	156,069	385,647	14,398,238	37·34	93,732
„ 1919	179	137,655	340,138	13,075,128	38·10	96,517
„ 1918	186	163,071	402,943	15,637,342	38·44	97,387
„ 1917	185	160,439	396,440	17,079,303	43·09	108,179
„ 1916	186	155,165	385,290	15,878,300	41·11	103,218
„ 1913	190	145,321	359,200	14,951,000	41·63	104,534

II.—SUGAR EXTRACTED.

Residencies and Averages.	Kg. per Hectare.	Lbs. per Acre.	On 100 Cane.	Yearly maximum output of any single factory. Kg. per Hectare.	Lbs. per Acre.
Cheribon	9,313	8,331	10,08	12,306	10,978
Pekalongan	11,053	9,860	10·19	13,072	11,661
Banjoemas	12,968	11,567	10·46	14,926	13,314
Kedoe	13,839	12,345	10·20	15,579	13,897
Djokdjakarta	13,055	11,646	11·42	15,744	14,045
Soerakarta	10,792	9,628	10·63	14,256	12,719
Semarang	8,791	7,842	9·33	10,357	9,240
Madioen	9,922	8,850	9,90	12,141	10,830
Kediri	10,183	9,083	10·31	13,690	12,212
Soerabaja	11,663	10,405	10·65	18,581	16,578
Pasoeroean	10,792	9,628	10·32	16,675	14,829
Besoeki	10,792	9,628	9·66	13,342	11,879
Average 1926	**10,966**	**9,782**	**10·38**	**18,581**	**16,578**
„ 1925	12,881	11,491	11·88	19,399	17,308
„ 1924	11,582	10,326	10·88	18,015	16,097
„ 1923	10,965	9,784	10,97	16,362	14,480
„ 1922	11,226	9,950	10·61	16,362	14,480
„ 1921	10,517	9,321	11·04	17,911	15,875
„ 1920	9,892	8,826	10·55	15,178	13,540
„ 1919	9,706	8,657	10·06	14,639	12,957
„ 1918	10,904	9,723	11·19	15,996	14,265
„ 1917	11,382	10,117	10·50	16,415	14,696
„ 1916	10,355	9,238	10·03	15,300	13,650
„ 1913	10,087	9,110	9·65	14,708	13,12

III.—Sugar Production in Tons.

Residencies and Totals.	First Sugars.	After-Products.	Total Production. After-products as 4 : 3.	Solidified Molasses.
Cheribon	101,631	1,966	103,105	2,112
Pekalongan	185,291	3,903	188,218	19,987
Banjoemas	80,110	211	80,268	8,521
Kedoe	57,383	259	57,577	5,259
Djokdjakarta	210,301	2,359	212,070	—
Soerakarta	186,716	1,182	187,602	—
Semarang	87,026	3,633	89,751	2,013
Madioen	83,720	734	84,270	—
Kediri	236,209	15,593	247,904	123
Soerabaja	320,388	7,381	325,924	26,537
Pasoeroean	268,304	25,510	287,437	16,062
Besoeki	73,465	5,411	77,523	17,911
Total **1926**	**1,890,544**	**68,142**	**1,941,649**	**98,525**
„ 1925	2,205,201	77,876	2,263,479	71,679
„ 1924	1,924,942	54,427	1,966,237	82,504
„ 1923	1,740,895	31,655	1,764,636	103,842
„ 1922	1,749,640	39,609	1,779,557	62,125
„ 1921	1,632,067	34,620	1,658,032	74,892
„ 1920	1,497,244	30,060	1,519,562	164,459
„ 1919	1,297,320	23,977	1,315,158	96,303
„ 1918	1,714,833	101,922	1,750,197	18,511
„ 1917	1,779,654	22,682	1,793,415	49,870
„ 1916	1,579,670	32,300	1,604,154	85,749
„ 1913	1,381,673	125,002	1,442,884	65,756

IV.—Sub-Division of the Crop in Percentages according to Assortments.

Residencies and Averages.	Plantation White Sugar: First running.	Plantation White Sugar: Second running.	Channel Assortment Refining Crystals, 98° pol.	Refining Crystals, 96·5°Pol.	After-products.	Total.
Cheribon	66·30	1·20	13·00	18·00	1·50	100
Pekalongan	69·60	3·30	6·10	19·50	1·50	100
Banjoemas	—	—	34·70	65·10	0·20	100
Kedoe	—	—	36·40	63·30	0·30	100
Djokdjakarta	81·80	0·50	9·60	7·20	0·90	100
Soerakarta	96·60	0·30	2·70	—	0·40	100
Semarang	50·90	1·40	19·50	25·10	3·10	100
Madioen	99·30	—	—	—	0·70	100
Kediri	69·40	—	16·30	9·60	4·70	100
Soerabaja	65·90	—	16·40	16·00	1·70	100
Pasoeroean	27·90	—	35·40	30·00	6·70	100
Besoeki	16·10	—	28·20	50·50	5·20	100
Average **1926**	**59·90**	**0·50**	**17·20**	**19·70**	**2·70**	**100**
„ 1925	56·99	0·55	18·62	21·23	2·61	100
„ 1924	54·45	0·99	25·69	16·78	2·09	100
„ 1923	53·11	1·06	28·91	15·20	1·72	100
„ 1922	52·85	1·53	27·45	16·46	1·71	100
„ 1921	53·42	0·12	28·05	15·33	3·08	100
„ 1920	51·71	0·83	30·41	15·08	1·97	100
„ 1919	49·70	2·10	23·10	23·30	1·80	100
„ 1918	45·90	3·20	27·00	21·00	2·90	100
„ 1917	50·30	1·90	40·60	6·20	1·00	100
„ 1916	48·10	2·90	37·30	9·70	2·90	100
„ 1913	32·90	6·80	30·00	20·90	9·40	100

V.—PERCENTAGE COMPOSITION OF THE CANE PLANTINGS OF :—

VARIETY.	1913.	1918.	1919.	1920.	1921.	1922.	1923.	1924.	1925.	1926
B 247	54	41	29	26	20½	17¼	15½	12½	8¼	4¾
POJ Canes	33	29	16	10	7	7½	6½	4¼	4¾	7½
EK 2	—	4	6	6	6½	6½	6	6¼	6	5
EK 28	—	6	23	32	39	39	40	43½	45¾	44
F 90	—	4	4	3	3	3¼	3	3	2¾	2½
DI 52	—	4	13	14	15	18½	21½	22½	24¾	27¾
Cheribon	8	3	1	1	½	—	—	—	—	—
Tjep 24	—	2	1	1	1	—	—	—	—	—
SW 3	—	1	1	2	2	2½	2¾	3	3	3
Various	5	6	6	5	5½	5½	4¾	5	4¾	5½
Total	100	100	100	100	100	100	100	100	100	100

VI.—FACTORY RESULTS DURING THE LAST DECADE.

	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926
CANE—										
Sucrose	12.82	13.63	12.38	12.94	13.41	12.87	13.06	13.10	13.90	12.40
Fibre	13.02	12.99	13.01	12.98	12.98	13.19	13.14	12.90	12.80	12.80
BAGASSE—										
Sucrose	4.10	4.34	4.03	4.07	4.12	3.85	3.75	3.60	3.30	3.00
Moisture	46.82	47.22	47.01	46.76	46.43	46.30	46.49	46.30	45.50	48.70
SUCROSE EXTRACTED BY MILLS	92.30	92.10	92.00	92.50	92.50	92.90	92.20	92.80	93.90	94.35
SUCROSE IN FILTER-PRESS CAKES	4.15	4.36	3.70	3.75	3.81	3.55	3.20	4.10	3.80	3.50
SUCROSE IN JUICE PER 100 CANE	11.83	12.55	11.39	11.97	12.41	11.96	12.04	12.17	13.08	11.70
PURITY OF RAW JUICE	85.80	86.50	83.70	85.40	85.30	84.60	84.60	83.70	84.00	80.90
PURITY OF FINAL MOLASSES	32.60	33.10	32.10	32.20	32.40	32.00	31.30	30.50	30.50	30.00
CALCULATED AVAILABLE SUGAR	11.40	12.17	10.60	11.31	11.73	11.23	11.51	11.51	12.45	10.87
SUGAR EXTRACTED PER 100 CANE	11.00	11.68	10.44	11.13	11.51	11.08	11.43	11.44	12.38	10.85
SUCROSE TURNED OUT PER 100 OF :—										
Cane	10.48	11.27	10.12	10.64	11.00	10.60	10.92	10.92	11.82	10.33
Sucrose in cane	81.75	82.61	81.66	82.23	82.67	82.36	83.10	83.35	85.03	83.30
Sucrose in juice	88.58	89.80	88.85	88.90	80.60	88.34	90.71	89.80	90.40	88.30
SUCROSE LOST PER 100 OF :—										
Cane	2.34	2.36	2.26	2.30	2.41	2.27	2.14	2.18	2.08	2.07
Sucrose in cane	18.25	17.29	18.34	17.77	18.12	17.64	16.90	16.65	14.97	16.70
Sucrose in juice	11.42	10.20	11.15	11.10	11.40	11.85	9.29	10.20	9.60	11.60
LOST IN BAGASSE PER 100 OF :—										
Cane	0.99	1.08	0.99	0.97	1.00	0.91	1.02	0.93	0.85	0.71
Sucrose in cane	7.72	7.92	7.99	7.50	7.46	7.07	7.77	7.10	6.10	5.73
LOST IN FILTER-PRESS CAKES PER 100 OF :—										
Cane	0.09	0.10	0.09	0.10	0.10	0.09	0.09	0.07	0.07	0.06
Sucrose in cane	0.74	0.73	0.73	0.77	0.75	0.70	0.69	0.50	0.50	0.48
Sucrose in juice	0.80	0.80	0.79	0.80	0.81	0.75	0.72	0.60	0.50	0.50
LOST IN MOLASSES PER 100 OF :—										
Cane	0.91	0.94	0.90	0.93	1.01	0.98	0.80	0.90	0.92	1.04
Sucrose in cane	7.11	6.95	7.27	7.11	7.16	7.62	6.09	6.90	6.60	8.39
Sucrose in juice	7.70	7.50	7.90	7.80	7.74	8.17	6.65	7.50	7.10	8.90
UNACCOUNTABLE LOSSES PER 100 OF :—										
Cane	0.35	0.24	0.28	0.30	0.30	0.29	0.23	0.28	0.24	0.26
Sucrose in cane	2.68	2.17	2.35	2.39	2.75	2.25	2.35	2.15	1.77	2.10
Sucrose in juice	2.92	2.54	2.46	2.50	2.86	2.43	1.92	2.10	2.00	2.20

had been disposed of at an average price of 9·81 guilders per picul of whites, 8·61 per picul of refining crystals basis 98° pol., and 8·46 guilders for sugar basis 96·5° pol.

We estimate the consumption in the territory of the Dutch East Indies at 200,000 tons or 3,300,000 piculs, all the balance being available for export.

The destination of the 1926 exports was as detailed below, in metric tons; and we give the corresponding figures for a few previous years as a comparison. The stocks of sugar still existent at the beginning of the 1926 grinding season are put at 16,170 tons and on the 30th of April, 1927, at 34,500 tons.

EXPORTATION OF JAVA SUGAR IN METRIC TONS.

DESTINATION.	1924.	1925.	1926.
Netherlands	17,126	18,329	71
Belgium	11,628	13,540	309
United Kingdom	100,235	23,501	4
France	114,151	29,352	618
Germany	2,596	5,910	10
Russia and Finland	33,911	26,278	3,349
Denmark	—	1,322	—
Norway	2,467	560	—
Italy	4,900	35	—
Portugal	1,017	3,255	—
Greece	16,795	21,521	—
Other European States	1,434	1,933	—
Canada	18,242	—	—
United States	4,919	—	—
Turkey	1,272	3,915	—
Port Said, etc., f.o.	152,569	105,793	6,388
British East Africa	—	331	208
Arabia	3,898	3,878	557
British India	538,615	755,762	753,712
Aden	—	—	3,139
Penang	15,798	18,258	22,819
Singapore	74,879	91,600	85,332
Siam	16,392	41,509	33,750
French Indo-China	—	1,629	2,462
Hongkong	313,955	216,921	184,728
China	86,249	232,558	167,861
Japan and Formosa	332,808	432,914	457,681
Australia	8,808	—	157
Other Countries	7,306	376	531
Total	1,881,970	2,050,980	1,723,686

In a paper on "Liquid Chlorine: Its Manufacture and Uses," D. A. PRITCHARD and J. H. HUBEL[1] mention in passing the use of this gas for the treatment of condensing water. "A good vacuum can be maintained only if the water-side cooling surfaces of the condenser tubes are kept perfectly clean. When the cooling water is drawn from the river, lake or sea, it is frequently found that a glutinous, clinging mud adheres so firmly that it can only be removed by mechanical means, steam and compressed air being of no use. This trouble is often due to some micro-organisms of the alga or amoeba type. It has been found that one part or less of liquid chlorine per million parts of water will maintain a perfectly clean condenser at a saving of about 50 per cent. of the labour alone for cleaning by mechanical means."

[1] *Chemistry and Industry*, 1927, 46, 254.

Note* on Saccharum Sinense (Roxburgh).

By NOËL DEERR.

In 1796 a certain Mr. DUNCAN sent from China to Calcutta a cane which was described by ROXBURGH as a new sub-species under the name *Saccharum sinense*. Numerous references to this cane are to be found in Indian publications up to about 1850 (after which date interest in sugar seems to have lapsed in India), and it is evident that this cane became widely distributed.

Recent studies in Java indicate that it has been there observed that BARBER's *Pansahi* group of Indian canes possess the specific characteristics of *S. Sinense*, and indeed BANNIER[1] treats *S. Sinense* as equal to *Pansahi* group.

There are to be seen in the Kew Herbarium and also at the Royal Botanic Gardens in Calcutta coloured drawings of the inflorescence and stalk of the original specimen of *S. Sinense*, either made by ROXBURGH or by an artist under his direction. Although the drawings are not made with great attention to taxonomic detail, a cane of the *Pansahi* group is at once recognized and it would be easy to find a Uba, Kavengire, Pansahi, etc., stalk which might have served as the model.

In the districts of Muzufferpore, Dharbhanga and Champaran there is a cane grown to some extent under the name of *Chinia*. It is on record that the Chinese cane of ROXBURGH was introduced with success to this area about 1840, and it is suggested as more than likely that *Chinia* is none other than the descendant of this introduction, Chinia being the barely changed local form of Chinese cane.

On the western side of the Gondak in the district of Saran a very similar cane is grown under the name *Pansahi*, and this BARBER has taken as the type specimen of the group ; between Pansahi of Saran and Chinia of Dharbhanga the present writer can find no difference and he believes that they are the same variety under different local names.

Under the general heading of *S. Sinense* BANNIER includes a cane Puri. There has possibly been some confusion of labels here, as Puri is a well known variety in Behar, south of the Ganges, and in various parts of Bengal. On casual inspection Puri as understood in these areas has the appearance of a " noble " cane and is certainly very remote from the Pansahi group.

Quite recently canes in this group have become of great economic importance and they are variously referred to as " Chinese," " Japanese," " Uba," and " Pansahi " canes. Although the term Chinese cane dates back over 100 years it may be objected to as implying a Chinese origin, whereas there is evidence that within recent times, i.e., about 1300 years ago, the cane was introduced from India to China ; a similar objection applies and more potently to the term Japanese. Uba is a well established term, and as applied to one particular variety of the group antedates the term Chinese cane.[2] In view, however, of BARBER's work on the canes of Northern India, and his selection of the term Pansahi as indicative of the type specimen, the writer submits that this name should be retained as generic for the group.

British Beet Growers, Ltd., a concern cultivating 500 acres at Feltwell Farm, Norfolk, with offices at 20, Copthall Ave., London, E.C.2., and a capital of £10,000 with £8110 issued, held their first annual meeting recently, and disclosed a loss of £2645. Only 4·4 tons of beet per acre had been realized.

[1] *I.S.J.*, 1927, 68. [2] *I.S.J.*, 1918, 164.

A Study of Cane Juice Defecation at Various *pH* Values.[1]

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Since the advent of *pH* control of lime defecation of juice in the raw cane sugar industry there has been much discussion regarding the *pH* value at which clarified juice should be maintained in order to obtain the best results. The *pH* values observed in practice vary from 6·8 to over 8·0. In considering what constitutes the maximum clarification we may take the appearance of the juice (turbidity and colour) as being a good criterion and of primary importance from an operating standpoint, but other phases must also be kept in mind, such as percentage of lime-salts in the clarified juice, elimination of colloids, volume and weight of mud, and total elimination of non-sugar substances as indicated by the percentage of organic non-sugars present in the mud. The investigation here reported was conducted at two Porto Rican raw sugar factories[2] during the season of 1926, the purpose being to obtain further data regarding the relation between *pH* values and the various factors which constitute good clarification and likewise the variation in this relation with different lots of juice.

Procedure and Methods Used.

The following procedure was adopted for studying cane juice defecation at various *pH* values. A sample of mixed juice was passed through a 200 mesh screen to remove large particles of suspended material; the *pH* value and colloid content by dye test were determined; a 100 c.c. portion of this sample was ashed and P_2O_5 and CaO were determined in a solution of the ash. The screened juice was then divided into four portions and each of these was limed to a different *pH* value, the exact value being determined electrometrically on the cold limed juice. The separate portions were then heated to the boiling point and maintained at that temperature for one minute, after which they were transferred to a steam-jacketed glass experimental defecator, and allowed to settle for 1 hour and 15 minutes at a temperature of 95-100°C. At the end of the defecation period, the volume of mud was noted and the supernatant juice was removed by syphoning.

These samples were then cooled to room temperature, and the following determinations made : *pH*, dye value, surface tension, colour, P_2O_5 and CaO contents, and general appearance and turbidity by careful comparison, being all diluted to 10° Brix in order to place them on a more comparable basis. The mud was removed from each defecator, and to each sample of mud 2 grms. of infusorial earth, which had been thoroughly digested and ignited, was added. These mud samples were filtered in weighed Gooch crucibles, washed sugar-free, dried, and weighed. The weight of mud was obtained by correcting for the the weight of infusorial earth used. Then the samples were ashed, and the percentage of organic material in the mud was obtained by difference.

The quinhydrone electrode method[3] was used for measurement of all *pH* values. This made determination of the *pH* of turbid liquors possible without dilution or filtration. The CaO and P_2O_5 determinations were made on an

[1] Paper presented before the Sugar Division at the 72nd Meeting of the American Chemical Society at Philadelphia, Pa., September 1926.

[2] The authors wish to express their appreciation of the many courtesies extended by the officials of the Fajardo Sugar Company and the South Porto Rico Sugar Company.

[3] See Dawson, *Sugar*, 1926, 28, 211-24, 262-4, 310-12, 369-70 ; *I.S.J.*, 1926, 498.

ashed sample of 100 c.c. of juice of known specific gravity. The ash was dissolved in HCl and HNO_3 and the insoluble material filtered off. The filtrate was diluted to definite volume and one aliquot was used for the P_2O_5 determination by the molybdate method; and the CaO content of the other was determined by the oxalate method, titrating with potassium permanganate. The colloid content was determined by the dye method described by BADOLLET and PAINE,[4] using a cataphoresis cell with an ultramicroscope and a 0·1 per cent. solution of the dye Night Blue.

The surface tension measurements were made with a Du Nouy tensiometer of the old type, which gave a value of 76 dynes per cm. for water at 30°C. These values are reported on the basis of surface tension of water equals 71·64 dynes per cm. at 30°C., as experiments using the revised technique for this instrument gave this value. The experimental defecators consisted of pyrex glass tubes 1 in. in diameter and 24 in. long, graduated at the bottom in cubic centimeters from 0 to 100 c.c. These tubes were jacketed by "Pyrex" glass cylinders 2 in. in diameter and 27 in. long. A cork fitted with a ⅛ in. steam pipe was inserted at the bottom and this, together with a cork at the top in which the inner tube was fitted, formed a steam chamber around the settling tube. The temperature was maintained approximately constant at 100°C. by a sufficiently rapid flow of steam.

The Ives tint photometer was used for colorimetric measurements. This instrument was equipped with a Rice scale giving –log t values direct. For these measurements a 3 mm. depth of solution was used. These readings were corrected for depth of solution and concentration, the standard being 1 cm. depth of solution containing 1 gm. of solids per 1 c.c. of solution. The data here given represent an average of the corrected –log t values obtained by the use of 5-colour screens covering various wave lengths of the spectrum. The darker the apparent colour the higher are the readings on this scale. These samples were filtered through hardened filter-paper to remove suspended particles of comparatively large dimensions before making the colour measurements. There was considerable very finely divided suspended material in the filtrates, so that the values represent both colour and colloidal turbidity. However, they give a comparative indication of the quality of the juice from this standpoint.

VARIATION IN DROP IN *pH* WHEN LIMED JUICE IS HEATED.

In the first few experiments particular attention was given to the drop in *pH* of cold limed juice when heated. The data obtained are shown in Table I. It was observed in different cases that approximately the same *pH* value for cold limed juice gave quite different *pH* values for clarified juice. This drop in the case of juice limed to a *pH* of 7·5 varied from 0·46 to 1·78 *pH* units. A similar variation was observed also in factory operation; that is, certain lots of juice limed to a definite reaction with phenolphthalein at the liming station gave clarified juice of lower *pH* value than others. Some factory observations indicated that the drop in *pH* upon heating was greater in the case of juice from cane which had been cut some length of time, but these observations were not extensive enough to warrant a definite conclusion. PAINE and BALCH have shown[5] that the hydrolysis of normal calcium phosphate with the production of a soluble acid salt is an important factor in the decrease in *pH* of limed cane juice when heated. This variation in the buffer

[4] *I.S.J.*, 1926, 28-8, 97-103, 137-40.

[5] PAINE and BALCH, "Some Relations between Hydrogen-Ion Concentration and Defecation of Cane Juice." *The Planter*, 1927. 78, 127-32, 148-50.

effect of the juice is significant in relation to an automatic electrometric control[6] of the *pH* of the cold limed juice in that this would not give a clarified juice of uniform *pH* unless the *pH* of the cold limed juice were varied in a compensating manner. Some juices showing a pronounced drop in *pH* were somewhat low in P_2O_5 content, but there are insufficient data as yet to warrant considering this an important factor, since the addition of phosphate in the quantities used did not cause any significant variation in the drop in *pH*.

TABLE I.—DROP IN *pH* OF COLD-LIMED CANE JUICE WHEN HEATED.

No. of Sample	*pH* of raw Juice		Juice at various *pH* values *A*	*B*	*C*	*D*
1	4·96	Cold-limed	8·16	8·64	—	—
		Clarified	7·26	7·76	—	—
		Drop in *pH*	0·90	0·88	—	—
2	5·04	Cold-limed	7·35	8·08	8·82	—
		Clarified	6·12	6·76	7·26	—
		Drop in *pH*	1·23	1·32	1·56	—
3	5·16	Cold-limed	7·50	8·02	8·58	—
		Clarified	7·04	7·48	7·68	—
		Drop in *pH*	0·46	0·54	0·90	—
4	5·24	Cold-limed	7·42	7·90	8·50	9·30
		Clarified	6·50	6·80	7·60	8·10
		Drop in *pH*	0·92	1·10	0·90	1·20
5	5·26	Cold-limed	7·50	8·13	8·60	9·06
		Clarified	6·42	6·79	7·44	7·70
		Drop in *pH*	1·08	1·34	1·16	1·36
6	5·02	Cold-limed	7·52	8·07	8·55	8·96
		Clarified	5·74	6·42	7·15	7·35
		Drop in *pH*	1·78	1·65	1·40	1·61
7	5·28	Cold-limed	—	—	8·45	8·84
($+P_2O_5$)		Clarified	—	—	7·72	8·02
		Drop in *pH*	—	—	0·73	0·82

RELATION BETWEEN PHOSPHATE CONTENT AND CLARIFICATION.

It was noted that the best clarification was obtained at a *pH* value for clarified juice much lower than was found in a previous investigation with different types of juice. The lots of clarified juice obtained in the present instance were somewhat turbid in appearance. The P_2O_5 content of the original juice was found to be extremely low, so that juice limed to a comparatively high *pH* value yielded a clarified juice which was high in lime-salts. This is a factor which may not influence the appearance of the clarified juice, but is an important consideration from a factory-operating standpoint, as an increase in lime-salts may cause a distinct increase in the amount of scale formed on heating surfaces, thus affecting heat transference and reducing the capacity of the boiling house toward the end ef each run. The low P_2O_5 content of the raw juice under discussion presented a spooial problem of defecation with lime alone. Lime defecation has been well described[7] as being primarily a function of the phosphate content of the juice and essentially a process for removing the coarser dispersoids from the juice by the formation of a flocculent precipitate within the juice. Thus, the addition of lime alone to a juice of low P_2O_5 content must be very carefully controlled to obtain the most efficient clarification, but more particularly to prevent a high content

[6] BALCH and PAINE, *I.S.J.*, 1926, 425-429.
[7] BOND, *I.S.J.*, 1925, 311-317.

TABLE II.—CHARACTERISTICS OF DIFFERENT LOTS OF CANE JUICE LIMED TO VARIOUS *pH* VALUES.[1]

Juice sample No.	*pH*	P_2O_5 gms./100c.c.	CaO gms./100 c.c.	Dye value	MUD: Per cent. by vol. (based on original juice)	MUD: Total weight (gms.)	MUD: Content of organic material (gms.)	Surface tension (dynes per cm.)	Colour (-log t)	Character of clarification judged by appearance.
I.—	4·96	—	—	1700	—	—	—	—	—	
A	—	—	—	—	—	—	—	—	—	
B	7·26	—	—	900	—	—	—	—	—	Fair
C	7·76	—	—	1050	—	—	—	—	—	Cloudy
D	—	—	—	—	—	—	—	—	—	
III.—	5·16	0·0150	0·017	1100	—	—	—	—	—	
A	7·04	0·0025	0·026	633	11·3	0·677	0·586	53·4	6·183	Fair
B	7·48	0·0023	—	733	13·5	—	—	52·4	6·021	Good
C	7·68	0·0014	0·048	700	24·3	0·064	0·546	52·8	6·410	Very cloudy
D	—	—	—	—	—	—	—	—	—	
V.—	5·26	0·0110	0·015	—	—	—	—	—	—	
A	6·42	0·0049	0·022	—	8·7	—	—	54·0	5·568	Cloudy
B	6·79	0·0047	0·028	—	9·6	—	—	55·3	4·791	Good
C	7·44	0·0030	0·038	—	9·8	—	—	54·4	5·827	Fair
D	7·70	0·0028	0·036	—	13·9	—	—	54·1	5·871	Fair
VII.—	5·28	0·0078	0·016	500	—	—	—	—	—	
A	7·88	0·0030	0·057	500	9·1	0·656	0·562	51·5	9·382	Very turbid
B	8·43	—	0·046	500	9·8	0·733	0·599	53·7	9·128	Fair ; dark colour
VIII.[2]—	—	0·0221	—	—	—	—	—	—	—	
A[1]	7·72	0·0026	0·033	300	16·3	0·676	0·577	55·3	6·798	Very good
B[1]	8·02	0·8035	0·036	500	15·2	0·732	0·564	52·1	7·186	Fair, but slightly cloudy
IX.—	5·32	0·0230	0·014	700	—	—	—	—	—	
A	7·22	0·0030	0·029	450	14·1	0·754	0·586	57·6	6·506	Slightly turbid, but fair
B	8·18	0·0024	0·039	500	18·3	1·023	0·736	56·7	5·762	Good
X.—[3]	4·46	0·0600	0·013	700	—	—	—	—	—	
A[1]	7·28	0·0046	0·035	420	32·6	0·959	0·656	58·6	5·665	Fair
B[1]	7·75	0·0026	0·037	400	25·1	1·058	0·717	60·3	4·626	Very good
XI.—	5·14	0·3900	0·016	1150	—	—	—	—	—	
A	6·46	0·0058	0·027	1100	13·0	0·838	0·599	—	—	
B	7·20	0·0046	0·030	1050	15·6	0·936	0·661	—	—	Good
C	7·68	0·0083	0·049	1050	14·1	0·899	0·628	—	—	Turbid poor settling

[1] Figures for Samples II, IV and VI here omitted.
[2] Sample VIII = sample VII with phosphate added.
[3] Sample X = sample IX with phosphate added.

NOTE.—The letters *A*, *B*, *C*, etc., designate subdivisions of juice samples I, II, II, etc., which were limed to different *pH* values.

of lime-salt in the juice. SMITH states[8] that it seems impossible to obtain a clear limpid juice, using lime alone, when the P_2O_5 content is below 0·02 per cent. Since the clarification apparently depends primarily upon the adsorption of colloids and the retention of more coarsely divided material by the phosphate precipitate, the quantity and character of this precipitate are quite important.

In Table III the extent of adsorption of colloidal material by a heavy precipitate is shown approximately by comparing the dye value of the raw juice with that of clarified juice from lime defecation and clarified juice from the double carbonation process. These samples were obtained at a factory producing granulated cane sugar by the double carbonation process and raw sugar by the usual lime defecation method. The dye values were obtained by dividing the weight of dye required to neutralize the electric charges of

TABLE III.—ELIMINATION OF COLLOIDS FROM CANE JUICE BY LIME DEFECATION AND DOUBLE CARBONATION AS INDICATED BY THE DYE TEST.

	Dye Values		
	Raw juice	Lime defecated juice	Double carbonation juice
	1470	1130	498
	1097	1052	380
	1364	1240	548
	1257	1200	420
	1472	1216	242
	1440	1275	390
Average	1350	1185	413
Per cent. Elimination	—	12·2	69·4

the colloid particles by the weight of solids in the juice sample and multiplying the quotient by 100,000 to give a whole number; the larger the dye value, the greater is the indicated colloid content.

While there is no correlation between individual samples, the averages represent approximately the comparative colloid elimination obtained in the two methods of clarification. The dye test showed a value of 1350 for the raw juice, 1185 for the juice clarified by lime defecation, and 413 for double carbonation process juice, or a 12·2 per cent. colloid elimination by simple defecation and 69·4 per cent. by the double carbonation process. However, at the time of this experiment the cane was in rather poor condition and the simple lime defecation gave relatively poor results, so that 12 per cent. colloid elimination is doubtless somewhat below the average for good clarification. The dye test showed a greater percentage of colloid elimination than this in a few of our experiments. In connexion with the double carbonation process, it is of interest to note that reducing to any appreciable extent the percentage of lime used (base on weight of cane) gave a clarified juice of increased colloid content.

It will be noted from Table II that colloid elimination by lime defecation, as indicated by the dye test, was particularly small in some cases. In fact, in the case of juice sample VII, which gave poor clarification at each of two *pH* values, no colloid elimination was indicated. This sample of juice had a low P_2O_5 content. It is possible, however, that there may have been an error in the dye value determinations for this sample. In general the surface tension of clarified juice increased with increasing colloid elimination and effectiveness of clarification. This relation is shown particularly by juice sample VI (Table II). The dye value decreased from 650 to 600, 550, 550 and 500 with

[8] Report of The Raw Sugar Technical Committee, 1924, Hawaiian Sugar Planters' Association. See *I.S.J.* 1924, 266, 322.

increase in the pH to which the juice was limed, whereas the surface tension of the subdivisions A, B, C and D of this lot of juice increased to 45·6, 48·9, 49·2 and 49·5 dynes per cm. As a rule, for the same sample of juice, the higher surface tension values correspond to the lower dye values, as is to be expected.

It appears that a considerable proportion of the suspended material which is eliminated by simple lime defecation is of greater than colloid dimensions. The dye values in Table II show that there is a great variation in the colloid content of different lots of cane juice.

In this connexion it is of interest to observe that values showing the colloid content of juice which are obtained by dialysis or ultra-filtration would be too high unless the juice were previously filtered by some means which removes all finely suspended material except particles of colloidal size. This is indicated by an experiment in a previous investigation[9] in which raw sugar solutions gave identical dye values before and after filtration through ordinary filter paper, showing that the material removed by filtration through paper either carried no electric charge or was so nearly neutral that it was impossible to detect an electric charge by the dye test.

In Table II are presented data showing various characteristics of clarified juice representing liming to different pH values. In a number of lots of juice which were found to be low in P_2O_5 content, the pH of the best clarified juice of the different series varied from 6·8 to 7·3, the increased content of lime-salts and a darker colour being the limiting factors at pH values higher than these. In one experiment a juice (sample VII) of low P_2O_5 content was divided into two portions. To one portion a small quantity of phosphate was added, increasing the P_2O_5 content from 0·0078 grm. per 100 cc. to 0·0221 grm. per 100 c.c. This sample of juice after addition of phosphate is designated as No. VIII in Table II. These two lots of juice were in turn divided into two portions. A and B (first column, Table II) are the two portions of the juice of low P_2O_5 content and A^1 and B^1 are the two portions of the lot of juice to which phosphate was added. The same quantity of lime was added to A and A^1 and likewise to B and B^1, the quantity being greater, however, for B and B^1 than for A and A^1. The clarified juices resulting from liming A and B were correspondingly higher in pH than those resulting from liming A^1 and B^1. However, the most striking differences are the higher CaO content of the two portions (A and B) of lower P_2O_5 content and the corresponding darkening in colour of these portions. The same procedure was followed in the case of another lot of juice (sample IX), but more phosphate was added and an attempt was made to obtain the same pH value regardless of the quantity of lime required. There was some increase in colour, but since the original juice had a higher P_2O_5 content (0·023 grm. per 100 c.c.), the differences are not so striking. The apparent clarification of both portions (with and without addition of phosphate) was much better than the average. Increasing the P_2O_5 content to 0·060 grm. per 100 c.c. (sample X) is more than sufficient for clarification; in fact, the original content of 0·023 grm. per 100 c.c. P_2O_5 gave comparatively good results. In the case of both lots of juice (VII and IX) the addition of phosphate increases the elimination of colloidal material by liming, as shown by the dye test.

During a survey of several raw sugar houses in Porto Rico it was observed that the pH of clarified juice varied considerably in different sections of the island. Samples were examined at each factory. In one sugar-house the

[9] BADOLLET and PAINE, *I.S.J.*, 1926, 609.

average *pH* of clarified juice was 7·15. Analysis of the dilute juice showed a P_2O_5 content of 0·010 grm. per 100 c.c. Two houses had an average *pH* of 7·6 and analysis of samples of dilute juice showed P_2O_5 contents of 0·022 and 0·025 grm. per 100 c.c. These factories maintained a close control of the liming station and were determining *pH* values frequently. They considered the *pH* value mentioned as being the highest permissible for the best results. At another factory no especial attention was given to the liming station and no *pH* control was used. Little trouble was said to be encountered in defecation. The resulting clarified juice was very brilliant in appearance. A catch sample of this juice had a *pH* value of 7·9. Analysis of this raw juice showed a P_2O_5 content of 0·046 grm. per 100 c.c. These practical observations, together with the experimental results mentioned, indicate that the usual limiting factor in defecation with lime alone is the P_2O_5 content of the juice, and furthermore, that the optimum *pH* for clarified juice bears a very close relation to the percentage of phosphate in the juice to be defecated.

There are no doubt other factors which affect defecation, such as the nature and quantity of the colloids of the juice as affected by the character of mill work, maceration, and condition of the cane. However, aside from considerable variations which may occur in the colloid content of cane juice, the most decisive factor in lime defecation is apparently the percentage of P_2O_5 in the juice, and, in addition, the experiments just described indicate that the optimum *pH* for defecation is largely determined by this value. We believe that this observation is sufficiently important to render advisable the systematic determination of P_2O_5 by raw sugar factory control laboratories in order that defecation may be maintained at as nearly as possible the optimum *pH* value. The character of the defecation affects not only the work throughout the sugar end of the raw sugar-house but also the quality of the raw sugar, since a syrup high in dye value will yield a sugar correspondingly high in colloid content. It has been shown in another investigation[1] that the dye value of a raw sugar is an index of its colloid content and many of its refining properties.

Sugar Beet Experiments in the West of England for 1926.[2]

By A. W. LING, B.Sc., N.D.A., and V. L. SMITH-CHARLEY, B.Sc.
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A uniform series of experiments, both manurial and cultural, was undertaken by the Western Provincial Advisory Committee[3] at the beginning of 1926 and the results obtained from these trials are reported in this bulletin. Certain general principles have been established on the Continent with reference to the cultivation and manuring of sugar beet, but it was realized that these principles must be verified by experiment in this country before they could be definitely accepted, more particularly in the West of England where conditions are somewhat widely different.

The main points brought out by Continental work are as follows: (1) The sugar beet crop makes very great demands on the soil, but a good

[1] *I.S.J.*, 1926, 609.

[2] Condensed from Bulletin 1, Department of Agriculture and Horticulture, University of Bristol, 1926.

[3] The Western Province consists of the counties of Somerset, Wiltshire, Gloucester, Hereford and Worcester.

return per acre can be obtained by the use of farmyard manure. (2) The application of phosphatic manures does not cause an increase in the sugar content. (3) On light soils potash is necessary as otherwise the sugar content is depressed, but on heavy soils, with the modern varieties of beet, no increase in sugar can be expected from extra dressings of potash. (4) Top dressings of nitrogen increase the yield of beet per acre and, if not applied too late, they do not depress the sugar content. (5) The best yields have been obtained by sowing the beet in rows 15 ins. apart on the flat. And (6) Singling is best done when the beets are 1½ in. high or earlier.

In order to ascertain if these observations held good in this country the following scheme of experiments was devised :—

MANURIAL TRIALS.[1]

		Approx. Cost of Manures. £ s. d.
Plot 1.	Complete manure, less 1½ cwt. muriate of potash, i.e., no potash	1 3 9
Plot 2.	Complete manure— 1 cwt. sulphate of ammonia[2] ; 4 cwt. 30 per cent. superphosphate ; 1½ cwt. muriate of potash	1 17 6
Plot 3.	Complete manure, less 2 cwt. supers, i.e., one-half of the complete dressing of phosphates	1 11 6
Plot 4.	Control—no manure	—
Plot 5.	Complete manure, plus an extra 1½ cwt. muriate of potash, i.e., double potash	2 11 3
Plot 6.	Complete manure (same as Plot 2)	1 17 6
Plot 7.	Complete manure, but the 1½ cwt. muriate of potash replaced by the equivalent amount of kainit or potash manure salts	

Top dressings.—A strip over the whole of the plots was top-dressed with 1 cwt. nitrate of soda at singling time and half this top-dressed strip again top-dressed with 1 cwt. nitrate of soda two or three weeks later. The total number of centres at which trials were laid down was 17, being :—Wiltshire 9, Somersetshire 5, Gloucestershire 3. The centres were classified according to the nature of the soil, i.e., sandy, loamy, heavy.[3]

RESULTS OF MANURIAL TRIALS.

An examination of the results from all centres[4] shows quite clearly that no very outstanding differences have been obtained either in the yield per acre or the sugar content on manured plots. The unmanured plots in almost every instance gave the lowest yields of beet per acre, but the same does not apply to the sugar content, indicating that manuring within reasonable limits will give an increased return per acre, but will not raise or lower the sugar content to any appreciable extent.

It is, however, very important to bear in mind several other factors which may have been operating. Firstly, the year 1926 was a very favourable one for sugar beet growing. Secondly, in selecting centres for these trials it was necessary to utilize land already chosen by the grower for the 1926 sugar beet crop. Such land was not usually the poorest on the farm, in fact in the majority of cases it would be the best and as such it would have been well farmed for the previous crops. The influence of previous cropping and manuring on succeeding crops would tend to minimize the results of manuring in 1926. It was felt, however, that these experiments would

[1] Certain other manurial trials, e.g., the effect of different nitrogenous manures, are reported in the Bulletin, although such trials were not carried out at all centres.
[2] Rate per acre.
[3] Details of this classification given in the original Bulletin are here omitted.
[4] For the actual figures obtained in these trials the original Bulletin must be consulted.

afford some justification or otherwise of the manuring adopted in the West of England for sugar beet.

Yield.—In almost every trial the unmanured plot (No. 4) produced a lower yield than the completely manured plots (Nos. 2 and 6). At centre No. 6 the yield was doubled as the result of the manuring. At other centres the increase was not so great, the majority averaging about 30 cwts. to 2 tons per acre increase.

From the results obtained in 1926 neither phosphate nor potash seem to play a very important part in increasing the yield of beet per acre. At some centres there was a tendency to a reduction of crop when the phosphate was halved (plot 3). The same thing appears to happen when potash is omitted, but no economical return is obtained on any of the soils from the double dressing of potash. In general it would appear that on the land selected in 1926, no economical returns were obtained by increasing the potash and phosphate dressings.

Sugar content.—Manuring, within the limits of these experiments, has had very little significant effect on the sugar content. A glance at the figures for each centre will be sufficient to show that the variations plot for plot are not very great, and in the majority of cases come within the limits of the experimental error. The only conclusion that can be drawn is that moderate manuring on soils which appear suitable for sugar beet will not affect the sugar content to any appreciable extent. It will be noticed that the sugar contents of the beets from the different centres vary considerably. It seems likely that sugar content is more dependent upon soil and climatic conditions and variety of seed than upon the system of manuring adopted.

General Conclusions.

In arriving at the conclusions and suggestions which follow due regard has been paid to experimental work which has been carried out on sugar beet elsewhere. It is quite obvious from the data presented that it is impossible to lay down hard and fast rules with reference to the manuring and cultivation of sugar beet, but the suggestions made below are merely given as a guide to those who contemplate growing this crop, as almost every case must be considered on its own merits.

(1) *Manuring.*—The average yield of washed beet obtained from all the plots in the province, numbering 102, is 14·5 tons per acre with an average sugar content of 19·6 per cent. Therefore, on most types of soil in reasonably good condition sugar beet was a highly successful crop in the West of England, producing in 1926 a good return per acre. In all cases the artificial manures have produced an increase in the weight of beet per acre, but very little response can be traced to increased dressings of either potash or phosphates above those of the standard plots. With regard to sugar beet, however, it must be borne in mind that the plant is a very gross feeder. For this reason the manuring of sugar beet should not be stinted, especially where the crop forms part of a rotation and large proportions of the manure (in the nature of dung and phosphates) are applied to roots for that and the succeeding crops in the rotation.

(*a*) *Nitrogen.*—Dung at the rate of 10-12 tons per acre should be applied in the autumn (or even to the preceding crop). A spring application immediately before the sowing of the crop has been found to produce "fangy" roots or excessive leaf growth, both of which are deleterious to yield and sugar content. Excessive nitrogenous manuring should be avoided, particularly in this area, where the growing season is a long one. Too much nitrogen produces an abundance of leaf, but no great increase in bulb. Ripening

of the beet is considerably delayed, which means that the sugar content will not rise to its maximum at the time of harvesting the crop. The value of steady slow-acting nitrogenous manures, such as organic manures, has not been investigated in detail, but there are indications that these manures may be useful in the basal dressing where farmyard manure is scarce or not available. Calcium cyanamide would appear useful as a nitrogen supplier in the basal dressing, particularly on soils short of lime. Top dressings of nitrogen proved to be of the greatest value in increasing the yield of beet per acre without seriously decreasing the sugar content. There was a tendency for the double top dressing to reduce the sugar slightly, but this was more than counter-balanced by the increased yield.

(*b*) *Potash*.—Large applications of potash do not appear to be economical; in fact during the 1926 season, on some soils, the value of potash appeared to be doubtful. It must be remembered, however, that a shortage of potash is not felt so badly in a season such as 1926 when the rainfall was more or less evenly distributed. Potash is very beneficial in assisting the crop to withstand drought, and whilst heavy dressings are not recommended, a moderate application should always be made as a safeguard, particularly on the lighter types of soil. No correlation could be traced between extra dressings of potash and an increase in the sugar content.

(*c*) *Phosphates*.—The inclusion of as much as 4 cwts. per acre of superphosphates in the basal dressing is not an economical proposition as judged by the results obtained from these experiments. If the beet crop is one of a rotation of crops and the major portion of the phosphate dressing for the rotation is applied to the root break, then the application is justified, inasmuch as there is very little washing out of the manure and the residue would be available for the succeeding crops.

SUGGESTIONS ON MANURING OF SUGAR BEET.[1]

	Light and Sandy Soils. Dung.		Medium and Loam Soils. Dung.		Heavy and Clay Soils. Dung.	
	With[2] cwt.	Without. cwt.	With. cwt.	Without. cwt.	With. cwt.	Without. cwt.
Sulphate of ammonia[3]......	1	1½	1	1	1	1
Superphosphate	3	4	2	3	2	3
Muriate or sulphate of potash	—	—	1	1½	0—½	1
Kainit (14 per cent.)	5	5	—	—	—	—

(2) *Cultivations*.—Under the conditions prevailing last year a distance of 16-18 in. between rows gave on the whole the most satisfactory results. It has already been pointed out that the distance used is dependent upon the type of inter-cultural operations practised, but within reasonable limits the narrower the rows the better. Four days to a week after the appearance of the first rough leaves is recommended as being the most useful time to single the beet.

In conclusion, the fact that these results are for one season (1926) only must again be emphasized. This season was a very favourable one for sugar beet.

The Cuban crop of 4½ million tons was allotted by Presidential Decree amongst the six provinces of Cuba in the following proportions: Pinar del Rio (10 centrals) 165,016 tons; Habana (13 centrals) 287,184 tons; Matanzas (27 centrals) 943,155 tons; Santa Clara (54 centrals) 903,500 tons; Camaguey (29 centrals) 1,347,885 tons; and Oriente (43 centrals) 1,303,259 tons.

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[1] Top dressings are applied in addition to the basal dressings given in the table.
[2] At the rate of 10 tons per acre of well rotted material.
[3] This may be replaced by calcium cyanamide, which should be applied a fortnight before sowing the crop.

Carbonation *vs.* Sulphitation in Java.[1]

By H. A. C. VAN DER JAGT.

Choice of Process.

When a muscovado factory is to be converted into a white sugar plant, or when the erection of a new factory for the production of S. H. S. (" superior first sugar," not less than 25 D.S.) is under consideration, there is the choice of applying raw juice sulphitation or carbonation. In the first process use is made of twice the amount of milk-of-lime employed in ordinary defecation, viz., about 8 litres of milk of 15° Bé. per 1000 litres of raw juice; whilst in carbonation at least 50 litres of 20° Bé. are added to the same volume of juice. In order to avoid glucose decomposition, one may apply in both processes the principle of " instantaneous saturation," in other words, the introduction of milk and gas (SO_2 or CO_2) so regulated that the excess of alkalinity remains low. Calcium sulphite or calcium carbonate respectively originate in the juice in this way, these behaving as precipitates giving body, so that slimy constituents, which otherwise would hinder filtration, are rendered inimical.

Advantages of Sulphitation.

Advantages of sulphitation are the following: (1) cheaper installation costs of the necessary apparatus; (2) lower costs of manufacture; and (3) in the case of a raw sugar factory turning to this process the fact that the personnel is already familiar with these several operations which also are applied in the white sugar factory, viz., defecating, subsiding, etc. In regard to point (1) it can be stated that for a factory of 12-14 thousand piculs of cane in 24 hours the construction costs can be estimated at about 60,000 Dutch florins less than for a carbonation factory of like capacity.[2] Further, calculations by Harloff, de Haan, and others have brought to light that the costs of manufacture per picul of white sugar are about 0·25 Dutch florin higher in the application of carbon dioxide than in the other method of working.[3] Having these values in mind, many have allowed their choice to fall on the sulphitation process, but without sufficiently considering a very important point, namely, the question of yield. In the carbonation process, one realizes a much more intensive elimination of non-sugar, so that both the purity and the colour of the juice are strikingly better than in sulphitation. This favourable result is not to be ascribed to the action of the carbon dioxide gas, but only to the use of more lime. Certain factories under the control of De Haan,[4] which had continuously for some years produced white sugar by the sulphitation process went over to carbonation work, and the difference in the installation before and after the conversion consisted principally in the manner of purifying the juice. He observed that per 100 piculs of white sugar introduced in the form of raw juice in the measuring tanks, about 2 piculs more of white sugar was obtained in the bags than previously in consequence of the improved juice clarification.

Advantages of Carbonation.

In connexion with the greater degree of purification of the raw juice observed, according to the amount of lime used, attention may be directed to a series of tests carried out by me in 1923, with Mr. Vertregt, factory manager of the Djatiroto sugar factory, in the laboratory of the M. T. S.

[1] Condensed from an article published in *Riet en BVet*, 1926, 1, Nos. 6 and 7.

[2] Or about £5000 less for a factory crushing 750 to 880 tons per day.

[3] That is, about 6s. 10d. per ton of 2240 lbs.

[4] *Archief*, 1911, 1341; 1917, 540.

at Dordrecht. We worked with diffusion juice five weeks old, which though carefully preserved with formaldehyde, added each week in small quantities, showed a fall of purity of about 4°, and in consequence contained a fair quantity of invert sugar. Litre quantities of the juice were treated by simultaneous saturation with gradually increasing amounts of lime; and results were obtained from which it was clear that, according as more lime was added, the nature of the juices was improved, principally because slimy colloidal particles were rendered less harmful. In the colloidal condition there were present partly as emulsoids and partly as suspensoids, gummy and protein substances, silicic acid, colouring substances, mud etc., while as coarse suspensions there were particles of fibre and of clay.[1] As the result of heating the juice and of liming, the emulsoids passed over from the sol into the gel condition, in other words, they were flocculated. If raw juice is clarified only with a little lime, as is customary in muscovado factories in Java, then one obtains slimy precipitates, which make filtration on the large scale impossible, the particles adhering together on the filter-cloth and forming an impenetrable layer for the juice. In order to effect rapid filtration on the large scale, a precipitate-giving body must be formed in the liquid; in carbonation this is $CaCO_3$, and in sulphitation $CaSO_3$, these precipitates having the tendency to adhere to the slimy particles. It is seen under the microscope that the hard particles of the body-giving precipitates are more or less pressed into the gel particles, that the surrounding juice is clear, and that the smallest gel particles are stuck fast to the greater part of the body-giving precipitate. In filtration, openings and channels appear in the cakes between the particles of the body-giving precipitate surrounding the gel particles through which the juice being filtered finds quite an easy passage. At the same time the coarse suspensions are held back with the favourable result that the juice runs from the cocks in a crystal-clear state. In carbonation the quantity of body-giving precipitate formed during saturation is at least ten times more than in sulphitation with all the advantages thus resulting.

Relative Colour Elimination.

In the choice between sulphitation and carbonation, one should give attention to another important point, and that is the influence which the well-known cane rind colouring substance, anthocyan, exerts on the colour of white sugar. Holm[2] found in 1909 in his crystallization experiments with rind colouring substances that, if sugar is crystallized from a mother-liquor in which anthocyan is present, the crystals have undesirable colour, not removed by washing with water, since it has penetrated the heart of the crystals. But in carbonation the colouring substances arising from the rind of the cane play no part, since in this method of working they are wholly eliminated from the juice. On the other hand, in factories which produce white sugars by raw juice sulphuring, such colours then play a rôle which can truly be termed hindering, their removal from the juice taking place only incompletely. Raw juice sulphiting factories must in consequence so far as possible work cane varieties which have a light coloured rind.

Production of Superior Whites.

So far the world's markets have made no differentiation between fine white Java S.H.S. and inferior white qualities. In the buying contract it is only stipulated that these sugars must have a colour at least equal to No.

[1] *Mededeelingen van het Proefstation voor de Java-Suikerindustrie*, 1922, 337.

[2] *Archief*, 1909, 800.

25 D.S. and that they must be free from lumps and other manufacturing defects. On the other hand, the requirements in the case of direct consumption white beet sugars are higher ; such must be much whiter. This striking difference is principally to be ascribed to the fact that cane syrups have in general a pleasant flavour and taste ; whereas in the case of beet sugars this is not so. It is however possible, and it may even be foreseen, that within a measureable space of time the world's markets will subject cane sugar to a stricter specification, differentiating between dead white and the inferior varieties of S.H.S., such superior sugars bringing perhaps 0·25 Dutch florin or more per picul.[1] If this should ever come about, then carbonation factories would more easily fulfil the more stringent requirements than sulphitation plants, at least for their whole output.

Resuming the advantages for carbonation factories we have the following: (1) They are independent of the cane variety to be crushed, since even varieties with the darkest rind can be worked without difficulty. (2) They realize a better non-sugar elimination, the troublesome colloidal particles being almost completely removed, and crystal-clear and light-coloured thin-juices obtained. (3) Their massecuites under otherwise similar conditions of concentration and temperature are less viscous, and more easily centrifuged, and the syrups more easily freed from the crystals. (4) They give a high yield, the higher costs of manufacture being to a large extent thus compensated. (5) They will be able more readily to fulfil the requirements of a higher grade of white sugar, when sooner or later this is demanded by the world's markets.

The old sugar refinery at Rawcliffe Bridge, near Goole, which has been closed down for a number of years, has lately been purchased by a firm of machinery merchants.

A series of experiments on the cultivation of the sugar beet in the United Kingdom is to be carried out by the Ministry of Agriculture this year.

An amendment to the Public Health (Preservatives, etc. in Food) Regulations[2] now specifies that, as in the case of sugar (including solid glucose), table syrups must not contain more than 70 parts of sulphur dioxide (SO_2) per million,

In Mauritius a special export duty on certain sugars has lately been instituted in order to pay off a Government loan which has been made for the purpose of assisting the sugar industry of the island. This loan which was authorized by an ordinance of 1926 has to be repaid within eight years, and accordingly an export duty of 50 cents. per 100 kgs. has been levied on all sugar of the 1927-28 crop graded above No. 12 D.S., the proceeds of which will be devoted to writing off the loan.

As showing the progress made by the Hawaiian sugar industry during the past 20 years, it is pointed out that from a 30 per cent. increase in acreage the total yield has increased 83 per cent. The yield per acre has increased, by reason of scientific cropping from 4·47 short tons in 1906 to 6·39 short tons in 1926. In 1906 a total of 430,000 short tons was harvested from 96,000 acres, whereas the 1926-27 crop comes to about 800,000 short tons.

At a meeting of the Indian Sugar Technologists' Association under the Presidency of Mr. Noël Deerr, it was decided to hold the first annual convention of the Association in early November, 1927. Sugar Technologists and others interested in the industry who intend visiting India will find it a good opportunity to attend the meeting and are requested to communicate with the Secretary, Mr. K. C. Bannerji, P.O. Ghughli, Dist. Gorakhpore. Papers on matters of interest to the industry will be gratefully received by Mr. Bannerji for reading and discussion.

[1] Say 7s. per ton.
[2] *I.S.J.*, 1926, 613.

Publications Received.

Die Zuckerfabrikation im Magdeburgischen. [The Early History of the Sugar Industry in the Provinces of Saxony.] By Rudolf E Grotkass. (Eilers Verlag, Magdeburg.)

This is a treatise in German on the early history of the beet sugar industry of the Provinces of Saxony prior to 1827 which the Chamber of Commerce of Magdeburg commissioned the author to write. It is at the same time a contribution to the history of the Continental system of Napoleon. Those students interested in the progress of the industry from the earliest times may find a perusal of this work not without its value. We notice that the author in writing of those early days when the beet industry was in its infancy mentions that there was considerable opposition to it in England on the part of some critics, though others were inclined to be more optimistic ; and it is recorded that a committee of Chemists was appointed in London to ascertain whether ACHARD's methods could be improved on. A chapter on beet seed throws some light on the question of the real origin of the Silesian sugar beet, the progenitor of most of the present strains in commerce.

The Engineer and the Prevention of Malaria. By Henry Home, M.Inst.C.E. 8vo, 176 pp. (Chapman & Hall, London.) 13s. 6d. net.

This is a useful work by a much travelled engineer, having in view the assistance of all those who go out to the tropics to undertake constructional work, and need a general knowledge of modern applications of anti-malarial measures, not only for their immediate protection, but also in respect to influencing their design of constructional work from the anti-malarial view point. Practical notes are given in details of works construction and the value of anti-malarial services, such as the use of oil and larvicides, the value of larvae-eating fish, etc. The design of houses and quarters is the subject of one chapter There is also an appendix of four sections by different writers, dealing with : mosquito netting ; applied entomology ; house flies ; and water.

Beta Vulgaris : Bilder-Atlas der Anatomie und Biologie der Zuckerrübe. Edited by the Botanical Section of the Agricultural Committee of the Ukrane. (Published by the Sugar Trust, Kieff, Russia). 1922.

This " atlas " of the anatomy and biology of the sugar beet (printed in the Russian, Ukranian and German languages) gives many beautiful illustrations of the plant and sections of it at progressive stages during health and in disease.

Transactions of the Institution of Chemical Engineers. Volume 3, 1925. (Institution of Chemical Engineers, Abbey House, Westminster, London). 1926.

In this volume are contained *inter alia* the following papers : " Studies in Filtration," by Prof. J. W. HINCHLEY, S. G. M. URE, and B. W. CLARKE ; " Steam Generation under Critical Conditions," by DAVID BROWNLIE ; " The Internal Combustion Boiler," by OSCAR BRUNLER ; " Distillery Waste Liquors and their Purification," by ROBT. D. LITTLEFIELD ; " Base Exchange Water Softening Materials," by E. B. HIGGINS and J. P. O'CALLAGHAN ; and " Doucil for Water Softening," by T. P. HILDITCH and H. J. WHEATON.

Reports of the Progress of Applied Chemistry. Volume XI, 1926. (Society of Chemical Industry, Central House, London, E.C.2.). 1927. Price : 7s. 6d. to Members ; 12s. 6d. to others.

Messrs. EYNON and LANE again contribute a very useful review of the progress made in cane and beet sugar manufacture and in refining ; Mr. S. G. M. URE writes on " General Plant and Machinery " ; Mr. H. J. PAGE on " Soils and Fertilizers " ; and Mr. H. LLOYD HIND on " The Fermentation Industries." As in previous years, these Reports form a summary invaluable to the chemist desiring to keep abreast of the advance in knowledge in matters bearing on his own particular line of study.

[1] *I.S.J.*, 1925, 217 : 1926, 324.

Publications Received.

The South American Handbook, 1927. Edited by J. A. Hunter. lxviii + 706 pp. Crown 8vo. (South American Publications Ltd, Atlantic House, Moorgate, London.)

This is a Pocket Guide to the Countries and resources of Latin America, including South and Central America, Mexico, British Guiana, and Cuba, which will be particularly useful for travellers and tourists, as it contains concise information on the various subjects of interest to those going a journey.

Trade Notices.

From the MIRRLEES WATSON CO. LTD., Glasgow, we are in receipt of several publications, the most interesting being an illustrated description of the Luabo Cane Sugar Factory of the Sena Sugar Estates, Ltd., on the Zambesi, reprinted from the *Engineer*. This factory was supplied by the Mirrlees Watson Co. Ltd., and it has, it is stated in a recent directors' report, given the utmost satisfaction. The nominal rated capacity of this factory is 50 tons of cane per hour, but the crushing rate has on occasion reached the figure of 75 tons, which means that in a normal season it is capable of producing 25,000 tons of sugar. The factory while arranged as at present to produce 96° raw sugar is designed to accommodate additional plant for the manufacture at a future date of plantation whites. The milling plant consists of a 14-roller set, comprising a crusher and four mills. This pamphlet, which is a useful description from the engineer's point of view of a typical modern British cane sugar factory installation, includes a large print showing the lay-out of the factory in plan and elevation. The other recent publications of this firm are a new catalogue of cane crushing machinery (S.10), and two prints on extra heavy duty cane mills, one in English and the other in Spanish. All the above can be obtained on application to the Mirrlees Co.

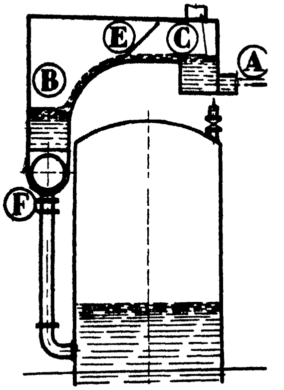
The CATERPILLAR TRACTOR CO., of San Leandro, California, who have in recent years absorbed both the Best Tractor Co., and the Holt Manufacturing Co., and now stand as the leading American agricultural tractor makers, have recently issued a brochure describing and illustrating the uses to which their tractors can be put. Besides their more general use as tractors of ploughs, wagons and harvesters on difficult ground, they have a multiplicity of uses where the great grip of their caterpillar wheels stands them in good stead. Thus, when fitted in front with a " bulldozer " they can push heaps of earth along and thereby level earthworks in a minimum of time; they can be used for shaping new roads with the aid of suitable scraping implements; in the off season they can be used to operate pumps by means of a connecting belt; for logging operations their great pulling power makes them indispensable; they can also clear firebreaks in forests and plantations, and pull stumps. These are but a few of their manifold general uses. Apropos of their pulling power, a test between a hundred young men trying to hold in a 30 h.p. caterpillar tractor resulted in the victory of the machine after 45 seconds struggle. The average pull per man ranged from 65 to 79 lbs. It may be added that the Caterpillar Tractor Co. attach great importance to a policy of co-operation with the various branches of industry which they serve, and they maintain an expert staff to advise and educate in methods of economic production, in this connexion endeavouring to keep in close contact with all interests engaged in the improvement and development of agriculture.

The KELVIN ENGINEERING CO., of 106, Front Street, New York, have issued a new English-Spanish Catalogue of sugar machinery which these well-known American engineers, contractors and manufacturers offer their clients. With an experience of 25 years in the sugar industry, this firm claim an equipment in personnel and plant that should guarantee the proper solution of varied sugar engineering problems, from the design and construction of a small piece of apparatus to the complete planning and installation of the largest and most up-to-date factory. Incidentally, the Kelvin Co. claim to be the pioneers in the electrification of cane sugar factories, and point to the successful results obtained from the beginning.

Review of Current Technical Literature.[1]

IMPROVEMENT OF THE STEFFEN PROCESS FOR EXTRACTING SUGAR FROM BEET MOLASSES. **Julius Bergé.**[1] *Sucrerie Belge,* 1926, **46,** No. 1, 1-10.

In an interesting paper read before the Société Technique et Chimique de Sucrerie (of Belgium) striking improvements in the Steffen process were described.[2] In the process hitherto applied in beet factories, there were present several serious defects, such as : a large lime consumption (125 to 150 kg. per 100 kg. of sugar in process, compared with 49 kg., the theoretical figure) ; part of the lime continued to react, causing an increase of temperature with a loss of sugar ; the formation of a rather impure saccharate (85 to 90° purify) ; and lastly the production of sugar which crystallized in needle-form, and was light, so that hard, dense sugar of the usual form could hardly be made. The late CARL STEFFEN, Sr., carried out long continued experiments to remedy matters, only with partial success. But his son (unfortunately now also deceased) by careful systematic investigation had better fortune, and at length evolved a method of working that is claimed to be a considerable improvement on the old method of working. In order to improve the reaction between lime and sugar, the apparatus used is on the principle depicted in the sketch shown herewith, the diluted molasses arriving at *A*, flowing in a thin layer down to *B*, the lime being introduced at *C* on a layer of liquid free from foam. Leaving *B* the mixture is agitated by a mixing device with arms 3 mm. apart, revolving at the rate of 500 revs. per min., this effectively disintegrating the lumps of lime, and producing a homogeneous milk. Dead-burnt lime and sand, etc., are later removed by passing the mixture through a decanting tank, after which it is pumped through the presses, there to give a cake of trisaccharate free from any active lime particles. So that instead of the high lime consumption mentioned, this has now been reduced to between 70 and 80 per cent. of the sugar in process, a very satisfactory result. Another advance is in the direction of improving the purity and the colour of the saccharate cake. It was early observed that the causes of defective cake arose from the formation of cracks and channels in them as they dried in the frames, making a proper washing impossible. This, however, was obviated by washing, not with water, but with a dilute saccharate suspension, and by following a certain routine based on this principle it is now possible to obtain saccharate which on carbonating gives a juice of 17° Brix and 98° purity.



DETERMINATION OF SUCROSE IN DRIED (DE VECCHIS PROCESS) BEET SLICES. **Lewis Eynon and J. Henry Lane.** *J.S.C.I.*, 1927, **46,** No. 18, 177-178T.

A method similar to that used by HERZFELD[1] for fresh slices may be used for dried slices after modification to take into account the volume of residual water in the slices, and the increase in volume of the extracting liquor, due to solution of sugar and other extractives : 52 grms. of the material are placed in a dry flask or bottle with 374·2 c.c. of dilute basic lead acetate i.e., the ordinary solution (1·23 to 1·25 density) diluted 20-fold, heating being carried out in a water-bath at 80° C. for one hour, and the vessel loosely covered during the first few minutes, but stoppered thereafter. After cooling to about 20° C., the solution is filtered and polarized in the 400 mm. tube, the reading giving the percentage of sucrose in the sample. If the filtrate is not quite brilliant, it may be made so by adding a small quantity of acetic acid, e.g., 0·1 or 0·2 c.c. to 100 c.c. of the filtrate, making up to 110 c.c.,

[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, I.S.J.

[1] Manager of the Tirlemont Refinery, Belgium.

[2] See Patents, *I.S.J.*, 1925, 228, 450, 622 ; 1926, 116, 500, 564.

[1] *Zeitsch. Ver. deut. Zuckerind.*, 1909, 627.

and increasing the polarimetric reading by one-tenth. The use of 374·2 c.c. of lead solution is correct for slices having a water content of 6 per cent., being 375·3 for 4 per cent., and 373·2 c.c. for 8 per cent. water content. Comparative determinations of sucrose in two samples of dried beet cossettes by : (1) the method just described; and (2) the method of determining the reducing power before and after hydrolysis with boiling, dilute hydrochloric acid, as previously described[1] gave a very close concordance of results, viz., 63·3 and 63·25, and 62·15 and 61·9 per cent. of sucrose. But the new method is much more expeditious than the other.

DETERMINATION OF SULPHUR DIOXIDE IN SUGARS. **R. H. Hurst.** *Tropical Agriculture,* 1927, 66.

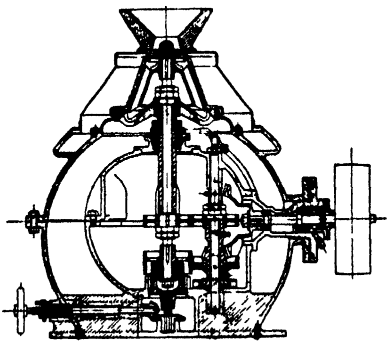
This subject has been investigated with a view to finding the method most suitable for adoption in cane sugar factories. In the first place, the lead sulphide stain method devised by J. S. MANN, and described by OGILVIE[2] has given very good results. The standard stains are oxidized on exposure to air, and so do not retain their original colour, but the stains corresponding to 25, 20, 15 and 10 parts of SO_2 per million differ sufficiently in depth of colour to be memorized after a few determinations have been made. Secondly, the ordinary titration method with iodine solution in the burette has been found to be entirely untrustworthy. Using this method a sample of grey sugar which had not been sulphured has an apparent SO_2 content of over 100 parts per million, and many samples of yellow crystals had an apparent SO_2 content over three times as large as the true content. Acidification of the sugar solution with a few drops of hydrochloric or acetic acid makes a remarkable difference and leads to a very much earlier and clearer end-point. In the writer's opinion, however, the most reliable titration method is the following : 5 grms. of the sample of sugar are dissolved directly in an excess (say 20 c.c.) of standard iodine solution to which have previously been added a few drops of hydrochloric acid. The sulphite is thus oxidized quantitatively to sulphate, and the excess iodine is determined by titration with standard sodium thiosulphate solution. The indicator, starch solution, should be added as late as possible so as to avoid precipitation of starch iodide. If this procedure is carried out carefully it can be said with confidence that the sugar does not contain a greater amount of SO_2 than that given by the experiment; though it may contain a slightly smaller amount. The results obtained have been found to agree very well with those given by the sulphide stain method. For sugar factory procedure it is sufficiently accurate to make up the standard iodine solution from a weighed amount of iodine as follows : About 2 grms. of potassium iodide are dissolved in as little water as possible in a weighing bottle, and this is weighed. About 1 grm. of iodine is added and the stopper or lid of the bottle replaced immediately and the weight is again taken. When the iodine has dissolved, the solution is run quickly into a 500 c.c. graduated flask containing about 1 grm. of potassium iodide dissolved in water and the solution is made up to the mark. The sodium thiosulphate solution is standardized from this iodine solution, the thiosulphate being placed in the burette. The standard thiosulphate should be kept in the dark in a blue Winchester bottle, and should, for safety, be re-standardized at frequent intervals with a freshly made iodine solution. For use in an experiment, the iodine solution may be diluted with water containing a little potassium iodine so that 1 c.c. contains 0·0002 grms. of iodine, i.e., corresponds to 0·00005 grms. of SO_2. In all cases, freshly boiled (and cooled) distilled water should be used. The author states here that the various samples of Trinidad yellow crystals with a fairly large grain which have been examined, have usually been found to be very easily within the limits of 70 parts of SO_2 per million, many of them, indeed, containing less than 25 parts per million.

A CONTINUOUS HYDRO-EXTRACTOR. **D. H. Killeffer.** *Industrial and Engineering Chemistry,* 1927, **19**, No. 2, 290-291.

A successful continuous hydro-extractor has been developed, primarily for dewatering coal, but its wider application to other problems is now merely a matter

[1] *J.S.C.I.*, 1923, **42**, 466T ; *I.S.J.*, 1924, 107.
[2] *I.S.J.*, 1926, 646.

of time. It consists essentially of a perforated basket revolving at high speed carrying on the dewatering operation and a set of scrapers which continuously remove the dried material from its interior. The basket is in the shape of the frustrum of a cone opening downward and mounted on a spider driven by a quill shaft. Within the basket the scraping flights are mounted on a similar cone driven by and mounted on a shaft passing through the quill. The top of the basket is open while that of the scraping cone is closed. On the top of the scraping cone, vanes are provided to assure an even distribution of the material fed in upon it. The scraping flights are rotated at a speed about one per cent. slower than the basket itself and thus gradually and continuously remove solid matter as it accumulates. As the dried material is scraped off it is thrown into a housing and falls into a hopper below. The liquid is caught in a housing around the basket. The advantages of this continuous machine lie in the reduction of manual labour and in avoiding the waste of large amounts of energy required for bringing the basket intermittently up to speed.



DETERMINATION OF REDUCING SUGARS, USING THE PERMANGANATE-FERROUS-SULPHATE METHOD. **Chas. S. Bisson and J. Gordon Sewell.**[1] *Journal of the A.O.A.C.*, 1927, **10**, No. 1, 120-124.

In a modification of this process proposed by CAVEN and HILL,[2] the cuprous oxide obtained is partly filtered off on filter-paper or asbestos and washed, and the remainder of the precipitate in the beaker washed by decantation, the cuprous oxide on the filter and in the beaker being then dissolved in a measured excess of an acidified solution of potassium permanganate. After the cuprous oxide has dissolved, boiling water is added to raise the temperature between 45 and 50°C. and the excess of potassium permanganate determined by titration with a standard solution of oxalic acid. This procedure, however, is admitted by CAVEN and HILL to be subject to certain difficulties. These are now avoided in the new modification of the present writers, which has been carefully compared with figures given by electrolytic determinations of the copper in the solutions remaining after the titration, and found to check very closely. Particulars of this convenient and accurate method now modified are as follows : *Solutions required* : (1) A standard solution of potassium permanganate containing 3·16 grms. of potassium permanganate per litre of solution, standardized with sodium oxalate ; (2) a solution of ferrous sulphate containing 28 grms. of ferrous sulphate ($FeSO_4 7H_2O$) and 10 c.c. of 96 per cent. sulphuric acid, sp. gr. 1·84 per litre of solution. Since this solution readily undergoes oxidation, its volumetric ratio with the permanganate solution should be determined for each series of analyses. *Preparation of Filter.*—Filter consists of an asbestos pad formed on a perforated porcelain filter-disc supported in a glass funnel. A bevel-edged perforated disc 25 mm. in diameter, supported in a 2·5 in. 60° short-stem funnel makes a convenient arrangement. The asbestos fibre used should be free from lumps and should form a uniform suspension when shaken up with water. A fibre having the proper texture was prepared by floating ordinary long-fibre asbestos, such as is used for quantitative work, in a cylindrical glass percolator. By regulating the upward flow of the water through the percolator, a suitable form of asbestos was separated from the unshredded, lumpy material and collected in a large suction filter placed beneath the percolator. *Procedure.*—After heating and boiling the Fehling's solution with the sugar solution, filter the mixture by means of suction

[1] Division of Chemistry, College of Agriculture, University of California.
[2] *J. Soc. Chem. Ind.*, 1897, **16**, 981 ; 1898, **17**, 124.

through the filter prepared as described. Wash the cuprous oxide and beaker well with warm water (60°C.) to remove soluble substances. It is not necessary to transfer all the cuprous oxide to the filter, as it may be washed by decantation in the beaker in which it was precipitated. Remove the funnel from the suction flask, invert over the original beaker, shake out the pad and plate, and wash all cuprous oxide adhering to the funnel into the beaker with about 10 c.c. of distilled water. Thoroughly disintegrate the pad by stirring with a glass rod. Add from a burette a quantity of the permanganate solution, in excess of that required to oxidize completely all the cuprous oxide; then add 10 c.c. of 18N sulphuric acid (sp. gr. 1·495) and stir the mixture until the precipitate is dissolved. The quantity of permanganate solution added should be sufficient to impart a deep purple colour to the solution and the sulphuric acid should not be added until the potassium permanganate solutions have been added to the suspension of cuprous oxide, because sulphuric acid decomposes cuprous oxide into cupric oxide and copper. While stirring the mixture, add from another burette 5 to 10 c.c. of the ferrous sulphate solution in excess of that required to destroy the pink colour of the permanganate. At this point in the procedure, no particles of unchanged cuprous oxide should remain in the mixture nor should any manganese dioxide adhere to the asbestos. Add distilled water to increase the volume of the solution to 250 c.c., and titrate this solution with the permanganate solution to the appearance of the usual end point. If the quantity of copper is sufficient to impart a blue colour to the solution after adding the ferrous sulphate, the colour change at the end-point will be from blue to lavender. The end-point can be detected easily and the colour does not fade any more rapidly than in the determination of iron with potassium permanganate. Calculate the weight of cuprous oxide in grms. from the following equations :—

$$(\text{Volume of } KMnO_4 - \text{Volume of } KMnO_4 \text{ equivalent to total volume of ferrous sulphate}) \times \frac{\text{Normal factor of } KMnO_4}{1000} \times \frac{143 \cdot 1}{2} = \text{Weight of cuprous oxide.}$$

If the weight of copper represented by the titration is desired, the atomic weight of copper (63·57) should be substituted for the constant 143·1 in the above equation. If the standard solution of potassium permanganate is 0·1N, 1 c.c. will be equivalent to 0·00715 grms. of cuprous oxide or to 0·006357 grms. of copper. Reference to the MUNSON and WALKER tables[1] will give the weight of the sugar equivalent to either cuprous oxide or copper. Cuprous oxide produced in the determination of sugars can be rapidly and accurately determined by this method, while the procedure does not require the use of expensive reagents, and large numbers of determinations may be made at comparatively small cost.

RECOVERY OF SUCROSE FROM CANE MOLASSES. **E. R. Watson, K. C. Mukerjee, the late D. N. Gupta, and H. S. Chaturvedi.**[2] *Quarterly Journal of the Indian Chemical Society*, 1926, **3**, No. 3, 229-244.

Undoubtedly BATTELLE's process gives a larger yield per cent. sugar in the juice, but the increase of yield has not been considered sufficient to justify the additional plant and treatment necessary. With slight modification the process might be suitable for the recovery of sucrose from cane-sugar molasses as a process by itself, *viz.*, by diluting the molasses and boiling with lime to destroy the invert sugar, then precipitating the sucrose as tricalcium sucrate, filtering, and treating with carbonic acid to liberate the sucrose. In this paper are described a number of laboratory experiments designed to establish the optimum conditions for the destruction of the reducing sugars by liming. boiling, and carbonating, but very irregular results were obtained, and no definite conclusion was obtained. One of these experiments was made in the following way: To a 12 per cent. solution of sucrose, an equal weight of caustic lime in a finely ground condition was added, the mixture stirred for four hours at a temperature of zero to 6°C., and the precipitate collected; then the filtrate was boiled with another 15 grms. of lime, and the above procedure

[1] *Methods of Analysis*, *A.O.A.C.*, 1925, 434.
[2] Government Technological Institute, U.P., Cawnpore.

repeated, the precipitates being united, and carbonated off, when the total final recovery of sucrose obtained was 84 per cent. Other recoveries were : (1) from a mixture of sucrose and glucose, 77·5 per cent. (2) from molasses containing 43 per cent. of sucrose and 20 per cent. of sucrose, 66 per cent. These authors found the calcium sucrate precipitated in their experiments to have a solubility much greater than is recorded in the literature for this compound ; and they remark that it would seem as if the calcium sucrate obtained in their tests were not the true compound, so that if the conditions could be found for separating the true calcium sucrate, the problem would be solved. However, they consider the results obtained by them so far to be promising from the commercial standpoint, having realized a recovery by the simplest process of 84 per cent. of sucrose in the form of a syrup of 70° purity, which they calculate should give them 24 of sugar per 100 of molasses treated. Taking the cost of the molasses (100 md. at Rs. 200) and of the lime used (60 md. at Rs. 45), and the value of the sugar (24 md. at Rs. 288) and the molasses (24 md. at Rs. 48) recovered, they regard the difference (viz. Rs. 91) to be a considerable margin for working charges.

DIFFERENT FORMS OF TINTOMETER COLOUR STANDARDS. *Communicated to this Journal by " The Tintometer, Limited."*

The original Tintometer devised for use in breweries contained two series of glasses termed series 50 and 52, which are two different shades of brown, found at that time to be the best means of recording the colours of malt extracts and beers, including black malts and stouts. Caramel manufacturers also found that series 50 and 52 approximately matched their products, and this led to the introduction of these standards to certain branches of the sugar industry for which they are quite unsuited. Series 500, another arbitrary series of amber colour, would appear to have been introduced to the sugar industry in a similar manner, being very convenient for matching some syrups. Undoubtedly the best standards for such an extensive range of colour as is found in sugar products are the Tintometer red, yellow and blue primary standards, by which all colours can be accurately matched and recorded. Owing to the fact that the series 50, 52 and 500 are entirely arbitrary, any attempt to reduce any one of them to terms of the primary standards or into terms of each other, is bound to give rise to serious error. In none of these scales is the proportion of red to yellow constant ; and, therefore, to make an accurate calculation of any reading in the arbitrary series into terms of the primaries it is necessary not only to specify the colour reading, but the actual value of each glass used to build it up. Thus, 60° series 500 in a single glass is equal to 6·0 red, 46·0 yellow ; 50° plus 10° series 500 is equal to 6·0 red 43·5 yellow, and the 40° plus 20° series 500, 5·85 red 52·0 yellow. And the same applies to the series 50 and 52. Various sugar chemists with whom colour measurement has been discussed point out that the use of the arbitrary colour standards is simpler, as it is only a matter of adjusting one glass instead of two or more. They find it easier to judge the colour depth in this way rather than make an exact colour match, and they complain that neither of the arbitrary scales are suitable for all their requirements. There is liable to be a considerably greater variation between two persons of normal colour vision with some experience in colour matching, making a measurement with arbitrary standards and judging the " colour depth " than by the same two persons making an accurate colour measurement with the primary standards. In practically all substances, colour is an indication of quality and undoubtedly much of the useful information obtained by accurate colour measurements is lost by adhering to rough and ready methods. It is apparent that a Universal Colour Standard is urgently required in the sugar industry. To simplify making colour tests, many industries have adopted fixed standards for samples of known qualities prepared to standard specification, with excellent results, the method of procedure being : One or more firms agree to submit typical samples of what they each consider to be the highest grade, the medium grade and the lowest grade samples of any particular substance prepared to the standard specification previously decided upon. The colour readings are taken and an average is obtained. These averages

establish fixed points and special compound standards are made from which all departures are recorded. Such standards established for the various processes of refining and for the finished products would undoubtedly be of great service to the sugar industry.

CAUSE OF THE "BURSTING" OF CHOCOLATE CREAMS. (*A*) **Margaret B. Church, H. S. Paine and John Hamilton.** (*B*) **H. S. Paine, Victor Birckner and John Hamilton.** *Industrial and Engineering Chemistry*, 1927, **19**, No. 3, 353-357, 358-363. (*A*) Considerable loss is incurred yearly by candy manufacturers in the U.S.A., due to the bursting of chocolate-coated cream centre candies. This has been found due to the presence ot yeasts that are highly sugar-tolerant, though unable to exist in products of very low sugar content, gas being formed as a product of the fermentation. Proper sanitary conditions at the factory, the use of sound ingredients, and the use of a cream of high syrup density will reduce this trouble. (*B*) In this second paper, it is stated that the trouble may be prevented by the addition of invertase to the fondant before the centres are moulded. In this way the invertase by inverting a portion of the sucrose present, and thereby increasing the total sugar solubility, causes such an increase in the density and osmotic pressure of the syrup phase of the fondant as to render it resistant to fermentation.—IMPORTANCE OF MOLASSES EXAMINATION IN BEET SUGAR MANUFACTURE. **H. Claassen.** *Chemiker Zeitung*, 1927, **51**, 14-15. Beet molasses having an apparent purity higher than 64° is still capable of further exhaustion in the factory, as researches at the Institut für Zücker-industrie have shown, and in Germany half of the raw sugar factories and the same proportion of those making white sugars are therefore losing sugar. This is a matter due generally to insufficiently thorough clarification, the return of an undue amount of first molasses to the first massecuite, and the inadequate treatment of after-products.—"AMETHYST" COLOUR IN WHITE SUGAR PRODUCTION. **H. Lundén.** *Centralblatt für die Zuckerindustrie*, 1927, **35**, No. 3, 73. During crystal growth, caramel substances are not easily adsorbed, but colours of amethyst shade are so, and it is these that cause trouble in affining and refining. Activated carbons have little effect on them, and the operations that act strongly on them are : liming, carbonating, filtration over char, treatment with kieselguhr, and re-boiling. In place, therefore, of the Stammer colorimeter, the spectrophotometer should be used. Good juices are darker in blue than in yellow light at the same *pH* value ; but it the difference in light absorption is small this is a bad sign, as such juice contains much amethyst colour, and poor sugars will be obtained.—BEET WHITE SUGAR MANUFACTURE, USING CARBONS. **Adolf Hinze.** *Centralblatt für die Zuckerindustrie*, 1926, **34**, No. 51, 1298-1299. Thick juice is boiled to granulated, and from the run-off an intermediate product is obtained which is affned with the after-product sugar, this being dissolved up to 60-70° Brix (hot), and treated with Norit and filtered. Complete re-crystallization thus results, giving a clairce of 99° purity. In a factory-refinery on Czecho-Slovakia 50 per cent. of the colour of the syrups (at 4·5° Stammer) is reduced by means of 0·3 per cent. of Norit to 2° Stammer, after which it passed over 8 metres of char, giving a Stammer reading of 1°. This method diminishes considerable the amount of after-product work, and increases the capacity of the plant without affecting the quality of the loaf, cube or granulated finally obtained.—DEGUIDE PROCESS OF EXHAUSTING BEET MOLASSES. **Emile Saillard.** *Supplement à la Circulaire hebdomadaire du Comité Central des Fabricants de Sucre de France*, No. 9168. A very full account is given of the operation of the Deguide plant at Gembloux, Belgium, which has a capacity of 40 metric tons daily. It extracts 95 per cent. of the sugar originally present in the molasses, and the loss of baryta is about 2 per cent. of the weight of molasses, fresh barium carbonate being used for replacing it. A plant of the capacity named occupies 2100 sq. m.—MOISTENING OF WHITE BEET SUGARS. **W. S. Twertzyn.** *Centralblatt fur die Zuckerindustrie*, 1926, **34**, No. 52, 1326-1327. Pure sugar will show signs of moistening when exposed to air having a relative humidity of 91 per cent. ; but when in course of time the sugar has suffered inversion then it may be low as as 77 per cent. Size of the crystals, time, and temperature are factors in this phenomenon.

J.P.O.

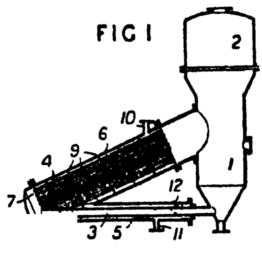
Review of Recent Patents.[1]

UNITED KINGDOM.

EVAPORATOR WITH HIGH VELOCITY HEATING DEVICE. **Wilhelm Vogelbusch,** of Ratingen, Germany. 265,517. November 16th, 1926.

In a heating element for evaporation or distillation or like apparatus, provision is made, not only for a high circulation velocity of the liquid under treatment, at the walls in contact with the heating vapour, but also for a heating surface which, practically speaking, offers no resistance to heat-transfer.[1] Referring to Fig. 1., a construction is illustrated in which the heating element consists of one or more horizontal tubes 3 of comparatively large cross section, a bank of inclined tubes 4, rising towards an evaporation chamber 1 and of comparatively small cross section, and a jacket 5, 6. The upper part of the evaporating chamber 1 forms a chamber 2 for the collection of the vapour from the liquid. The bank of small rising tubes 4 communicates with the outer end of the large horizontal tube 3 and discharges into the evaporating chamber 1, the lower part of which communicates with the tube 3.

FIG I



The jacket of the heating element is composed of a part 5 enclosing the tube or tubes 3, a part 6 enclosing the bank of tubes 4 and a cover which closes the header 7. The two parts 5 and 6 of the jacket of the heating member communicate with one another only in the neighbourhood of the header 7. Deflecting walls or baffles 9 are arranged in the part 6 of the jacket to constrain the heating vapour, which enters through an inlet 10, to follow a tortuous course inside the jacket 6 so that it flows between the tubes 4 in a direction which is always more or less perpendicular to the longitudinal direction of the said tubes. The heating vapour, after entering the jacket 6 by the inlet 1C, flows therefore, in a zig-zag course through the said jacket and passes finally into the part 5 of the jacket whence it emerges through an outlet 11. The liquid in the chamber 1 fills also the tubes 3, the header 7 and the tubes 4 in which it is heated by the heating agent which circulates around said tubes. Due to the heating the liquid in the tubes 4 is forced upwardly, while the cooler liquid in the chamber 1 is caused to move downwardly thus maintaining a circulation. The point at which the tube or tubes 3 communicates with the chamber 1 may be so disposed that there is always a portion of the liquid at rest in said chamber 1, of advantage when solutions are to be evaporated which deposit salts. By suitably arranging and distributing the baffles 9 in the jacket portion 6, it is possible to obtain any desired or necessary velocity of the heating vapour and to maintain the same constant over the entire course thereof in spite of the fact that the quantity of vapour may continuously decrease. It is also possible, however, to make the velocity of the heating vapour larger or smaller at will. In flowing through the jacket the heating vapour drives before it not only any condensate present but also the permanent gases, usually air, into the part 5 thereof, whence the said substances, which would otherwise impair the heat-transfer, may be removed. The condensate flows out through the outlet 11 and the permanent gases may be drawn off through a separate outlet 12. It is possible in this manner to ensure that the heating surfaces of the tubes 4 remain free from condensate and permanent gases so that the heat-transfer is not hindered.

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[1] Copies of specifications of patents with their drawings can be obtained on application to the following—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price 1s each). Abstracts of United Kingdom patents marked in our Review with a star (*) are reproduced from the *Illustrated Official Journal* (*Patents*) with the permission of the Controller of H.M. Stationery Office, London. Sometimes only the drawing or drawings are so reproduced. *United States:* Commissioner of Patents, Washington, D C (price 10 cents each) *France:* L'Imprimerie Nationale, 87, rue Vieille, du Temple, Paris *Germany:* Patentamt, Berlin Germany

[1] Consult also the patentee's previous Specifications, e.g., U.K. Patent, 196,935.

CONFECTIONERY, ETC. (*A*) **Soc. Fraisse Frères, A. A. F. Rambaud, P. O. Navarre and P. Navarre** (trading as **Soc. P. Navarre & Fils**), of Paris. 264,156. January 4th, 1927; convention date, January 8th, 1926. (*B*) **H. J. C. Forrester** (communicated by the **Ideal Wrapping Machine Co.**, of Middletown, New York, U.S.A.). 266,599. July 20th, 1926. (*C*) **Boggild and Jacobsen,** of Copenhagen, 266,667. October 5th, 1926.

(*A*) In making crystallized fruits, the fruit is treated, in an autoclave having heating means, with sugar syrup which flows slowly under pressure through a series of autoclaves entering and leaving at the upper part of each so that displacement of the syrup therein is obtained by the differences in density. (*B*) Relates to caramel cutting machines of the type in which the candy dough is forced against cutters by presser feet and scored. (*C*) A machine for continuously casting chocolate, adjustable for different forms of chocolate from pastilles to large cakes, comprises a uniformly moving endless belt carrying mould plates and an oscillating filling hopper. The mould plates are interchangeable, and the mechanism for oscillating the hopper and operating the filling pump is adjustable to suit the different forms of chocolates.

PRODUCTION OF ACTIVE CARBON ("SUCHAR").* **John J. Naugle,** of 300, Macon Street, Brooklyn, New York, U.S.A. (*A*) 267,240; (*B*) 267,241. December 14th, 1925.

(*A*) Active carbon is produced from pre-carbonized material by subjecting it to the action of air or steam or both these agents, while being heated by the passage of an electric current through it. To increase the conductivity of the material, conducting carbon, e.g., graphite may be mixed therewith. An electric furnace in which the process may be conducted comprises a casing 10, Fig. 1, having trunnions 11, 12 which act as inlet and outlet respectively. Rotation of the casing is effected by means of an annular gear 17 which co-operates with a spur gear 18. Within the casing are removable stirring members 20, Fig. 4, having hollow faces 25 which act as supports for stud-electrodes 20^1. Current is supplied through conductor rings 30, 31 in such a manner that adjacent electrodes are oppositely charged. Material fed into a hopper 40 is led into a central chamber 41, Fig. 5, of a spiral feed device 42 located at the inlet end of the casing 10 and enters the latter through a discharge opening 43. Air or steam is introduced through the inlet 11. The treated carbon leaves the casing by means of a similar spiral device at the outlet end. As raw material, the carbonized lignin residue obtained by carbonizing the waste alkali liquors produced in paper manufacture is preferably employed. The latter in the form of a slurry, possibly after being subjected to a preliminary process by means of which the lighter carbon particles are separated from a fraction containing heavy mineral constituents is passed to a filter, washed with water or acidulated water and then dried. It may then be mixed with fluoride, e.g., sodium fluoride, in order that mineral matter such as silica may be volatilized during the subsequent treatment, and with a flux, to facilitate separating mineral matter as clinkers. The product may be further subjected to a heat treatment in an electric furnace with exposure to air and is then passed by means of a cooled conveyor to a hydrochloric acid bath in which it may be

FIG. 1.

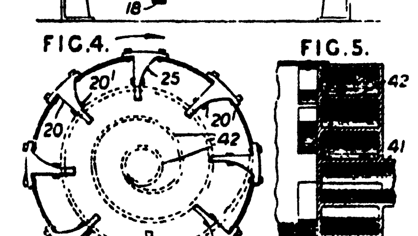


FIG. 4.

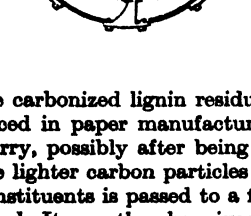
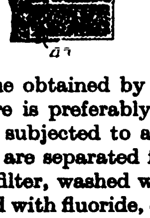
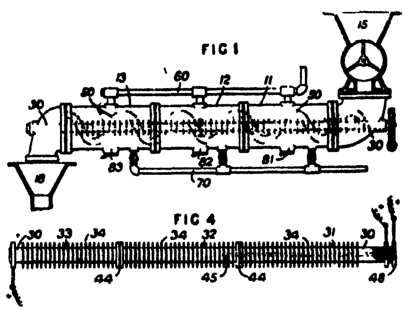


FIG. 5.



separated into lighter and heavier fractions. The carbon is finally filtered, washed free from chlorides, dried for example in a steam heated shelf-dryer and ground.

(*B*) Comminuted carbonaceous material such as the carbonized ligneous residue obtained in paper pulp manufacture or spent decolorizing carbon is converted into active carbon by subjecting it in stages to successive heat treatments, in the presence of air or steam or both, at different temperatures by passing through it electric currents of varying intensities while agitating and advancing the material through an electric furnace. During the heat treatment most of the mineral matter present is fused and separates as clinker, and the remainder may be removed from the product by means of acid. Fluorides may be added to the charge to remove siliceous impurities by volatilization. Carbonized paper pulp residue in the form of a slurry may be subjected to a preliminary treatment in order to separate, by settling, the lighter carbonaceous matter from the heavier material rich in minerals. The enriched carbonaceous material is then filtered, washed with acid and dried in a rotary kiln before activation in an electric furnace, Fig. 1. The furnace comprises cylindrical metal sections 11, 12, 13 which are insulated from one another and serve as external electrodes, the current passing between the latter and an internal rotary electrode shaft 30 divided into three insulated sections 31, 32, 33, Fig. 4. The shaft is provided with conducting vanes 34 and also with stirring means 50 which facilitate the passage of the material charged in through the hopper 15 to the outlet hopper 18. The sections 31, 32, 33 are insulated from one another by gaskets 44 and to enable current to be supplied to the central section 32, a conductor 45 is passed from a flange 48, which is insulated from the section 31, through a central passage in the latter. Air or steam or both these agents are admitted under pressure through a pipe 70 and the gaseous products are removed through pipe 60 which leads to a condenser and water seal. The various operations, such as the partial combustion effected by the treating gases may be regulated according to the condition of the samples removed through test holes 81, 82, 83. The product may be collected in a water-cooled conveyor and passed to a washing tank. If the suspension of carbon is not agitated, a separation of the lighter from the heavier fraction may be effected. After treatment with acid, the carbon is filtered, washed and dried.

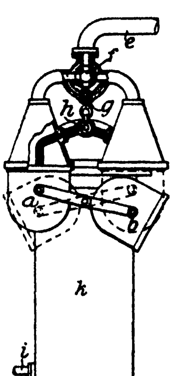


APPLICATION AND REVIVIFICATION OF ACTIVE CARBON ("SUCHAR" PROCESS). **John J. Naugle**, of 300, Macon St., Brooklyn, New York, U.S.A.. 267,242. December 14th, 1925.

Raw sugar or saccharine liquors in the sugar industry are refined by treating the raw sugar melt or the liquid in batches, preferably without previous filtration or defecation, with vegetable carbon which is derived from carbonized liquid residues according to either Specification 267,240 or 267, 241 (above). The melt is subjected to two or more treatments with the carbon on the counter-current system, the impure melt or liquid meeting the more nearly spent carbon and the purest melt or liquid being treated with the most highly activated carbon. The number of treatments is determined by the degree of purity desired. Filtration follows the final treatment. The spent carbon is revivified for further use in an electric furnace of the form described in either of the above-mentioned Specifications. In the example described, raw sugar which may be of about 96 per cent. purity is washed, for example in centrifugals, and the washed sugar of about 99 per cent. purity melted and about one or two per cent. by weight of the decolorizing carbon of the weight of sugar in the melt, added. The carbon removes most of the gums, pectins, and other colloidal substances together with a high percentage of the mineral substances dissolved or in suspension in the melt. After treatment with the carbon on the counter-current principle in 2-4 or more batches the melt is filtered, and on being sent to the pans yields at least

four or five successive crystallizations of white granulated sugar. In treating the liquors obtained on washing the raw sugar about 4-10 per cent. of the carbon by weight relative to the amount of sugar therein is added. The sugar from these wash liquors, which is generally light yellowish in colour, may be mixed with the sugar obtained from the raw sugar melts in such proportions as to give a standard white granulated sugar. The carbon is revivified by heating in the electric furnace to about 350-450°F. for 15-60 minutes, preferably 30 minutes, until the impurities are burned away, little or no combustion of the carbon itself taking place as it does not commence to burn until about 600-750°F. The furnace has controllable means for supplying air or steam or both, and the carbon is capable of repeated revivification. Reference is made to defecation of the raw sugar melt with acid calcium phosphate, and to its pre-filtration using such media as paper pulp, diatomaceous earth, sawdust, charcoal, etc.

PROCESS AND APPARATUS FOR RECTIFYING AND DEHYDRATING ALCOHOL. **E. A. Barbet**, of Paris. 264,050; addition to 224,931. April 26th, 1926. In rectifying alcohol under vacuum as described in the parent Specification[1] in a first column evacuated by a pump, a preliminary purification of the alcoholic liquid, and separation of the gases is effected in two columns. Vapours from the top of one of the two columns are used as heating agent and are condensed in a tubular boiler at the base of the first column. The condensate passes to a float chamber from which gases rise in a pipe and liquid is forced by a pump into the column, operating under atmospheric pressure.—COOLING GRANULAR MATERIALS. **Uno Co., Ltd., and P. B. Benkert**, of Minories, London. 264,633. November 20th, 1925. Apparatus for cooling granular or powdered materials comprises a rotary drum provided with internal helical or inclined ribs adapted to disperse the material through a current of cooling air drawn or forced through the drum by a fan, the material being fed into and discharged from the drum at the same end through which the cooling air enters. —EVAPORATOR WITH SEPARATE HEATER. **Berten & Co. Ges.**, of Viersen, Rhineland, Germany. 265,127. July 19th, 1926; convention date, February 1st, 1926. In evaporating sugar or other solutions, the solution is heated by being passed from an inlet *i* through a worm contained in a steam chamber *k* and is discharged through a three-way cock *h* into one or other of the vessels *a*, *b*. The vessels are adapted to be connected to a vacuum connection *e* through a three-way cock *f* and a smaller cock *g* which serves for the preliminary exhaustion of air. One of the vessels is exhausted and receives the heated solution, while the other is being emptied.—TOPPING BEET, ETC. **J. P. Humphreys**, of Preston, Wellington, Shropshire. 265,776. February 12th, 1926. The root to be topped is placed in a recess in a block and is cut by a knife attached to a lever actuated through a pin and slot connection by a lever. This lever may be hand operated or may be operated by a treadle. A slot may be formed in the block to receive the knife.—PREPARATION OF GLUTAMIC ACID FROM DESACCHARIFIED BEET MOLASSES, ETC.[2] **L. Mellersh-Jackson** (communicated by the **Larrowe Construction Co.**, of Detroit, Mich., U.S.A.). 265,831. May 17th, 1926. Glutamic acid is obtained from the residual liquors of the beet sugar industry by raising the temperature of the liquor after the betaine hydrochloride and alkali metal chlorides have been separated out by the addition of hydrogen chloride in known manner. In an example, desaccharified molasses is saturated with hydrogen chloride gas at a temperature below 70° C. On standing, a precipitate settles and is filtered off, and consists chiefly of potassium chloride and betaine hydrochloride which is separated in known manner by extraction with alcohol. The mother-liquor is then heated to a temperature below 95° C., and on cooling glutamic acid hydrochloride crystallizes out.



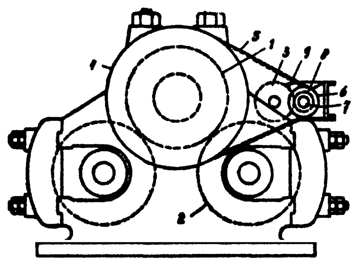
[1] *I.S.J.*, 1925, 112.

[2] Compare U.K. Patent, 248,453; *I.S.J.*, 1926, 389.

UNITED STATES.

Three-roller Mill with Auxiliary Feed Roller. **Abraham Marie Jan Meesters, of Djokjakarta, Java (assignor to N. V. Constructie Atelier de Vorstenlanden, of Java).** 1,621,077. March 15th, 1927.

A feed roller with longitudinal grooved or other unevennesses is arranged between the top and the front roller of the mill nearer to the front than to the top roller, and is rotated in the same direction as the front roller, its effect being further improved if it is rotated with a 10 to 25 per cent. greater velocity than the other rollers. Referring to the figure, between the top roller 1 and the front roller 2 of a three roller-mill a feed roller 3 is arranged nearer to the front roller than to the top roller as shown. This feed roller is disposed above the top roller and is driven from a sprocket wheel 4 carried by the shaft of the top roller. By means of a chain 5, this wheel is coupled to another sprocket wheel 6 fastened to a shaft 7, which carries a toothed wheel 8 meshing with a wheel 9 fastened to the shaft which carries the feed roller 3, so that the latter is rotated in the same direction as the front roller 2, the relations, i.e. the dimensions of the sprocket and toothed wheels, being such that the circumferential speed of the feed roller is greater than the said speed of the mill-rollers. The operation of the roller mechanism is as follows : The material to be ground is fed to the mill at the front over the top of the feed roller 3. This roller 3 is spaced, as above-described, closer to the front roller 2 than to the top roller 1. A feed passage is thus provided between the opposed surfaces of the rolls 1 and 3, while a relatively restricted space is provided between the rolls 2 and 3, which may be just sufficient to allow proper clearance. The material supplied over the top of the roll 3 strikes the surface of the roll 1 and is thereby deflected downward and forward through the feed passage between the opposed surfaces of the rolls 1 and 2 and to and between the biting surfaces of the rolls 1 and 2. As the roll 3 rotates in the same direction as the roll 2, and in the reverse direction to that of roll 1, but at greater circumferential speed, its tendency is to push the material forward against the surface of the roll 1 and downward between the biting surfaces of the rolls 1 and 3, and; by reason of the close proximity of roll 3 to roll 2, the material is prevented from working back into the restricted space between the two. The spacing between rolls 1 and 3 is such that the opposed surfaces of said rolls which form the feed passage also provide co-acting feed surfaces, The roll 1 is thus caused to have an additional function, i.e., that of serving with the roll 3 as a feed roll while also performing its usual function of a grinding roll. As the rolls 1 and 3 in their feed action rotate at different speeds a new working function is obtained, that of providing a differential speed feed motion, whereby that part of the material engaging the roll 1 is fed forward at a somewhat lower rate of speed than that part of the material engaging the roll 3. The effect of this is to cause a more even and uniform intermixing and distribution or spreading out of the material under feed to prevent bunching and to secure a more regular and uniform gripping and pressure action of the rolls 1 and 2 thereon. By this means, and as a result of the downward and forward force-feed pressure of the roll 3 on the material due to its faster speed, whereby backward motion of the material is resisted, any tendency to clogging of the rolls 1 and 2, such as occurs normally from an insufficient gripping action of their biting surfaces, is prevented.



Process for Removal of Colouring Matter and Impurities from Solution. **Marcel Levy (assignor to The International Sugar and Alcohol Co., Ltd., of London).** 1,615,091. January 18th, 1927. A process for removing colouring matters and other impurities from solutions consists in treating the said solutions with the lignin residue that is obtained as the result of the action of acids upon substances containing cellulose, said lignin residue being in the moist state as it is

left after washing.—JUICE CARBONATING APPARATUS. **Herbert N. Kilby,** of Cleveland, Ohio, U.S.A. 1,615,175. January 18th, 1927. A carbonating vessel comprises an alkaline sugar juice receiving tank in communication with the vessel, a pipe for conducting said juice from the tank to the vessel, a casing carried by the tank, a pipe structure for conducting a partially absorptive carbonic acid containing gas to the casing, a pipe for conducting gas from the casing to the vessel, means for simultaneously conducting sugar juice and a partially absorptive gas of substantially equivalent pressures to the tank, and means operable by the unabsorbed gases released from the sugar juice in the tank for varying the flow of gas from the casing into the gas conducting pipe leading to the vessel.—USE OF DEXTROSE MEDICINALLY. **Vincent A. Lapenta and Simon Reisler,** of Indianapolis, Ind., U.S.A. 1,615,226, January 25th, 1927. A process of reduction which utilizes the combined action of formaldehyde and glucose in an alkaline medium and the interaction on glucose of alkali and formalin producing a reaction product that stabilizes the colloidal dispersion of bismuth particles.—RECOVERING SUGAR FROM THE AIR CURRENTS IN DRYERS. **Otto Faber** (assignor to the **Geo. L. Squier Mfg. Co.,** of Buffalo, N.Y., U.S.A.). 1,615,872. February 1st, 1927. In the process of manufacturing sugar, the herein described method of recovering sugar from air currents discharged from a sugar dryer used for drying wet sugar of crystalline form, consisting of passing the air immediately upon leaving the dryer into contact with a plurality of films of water to cause the water to take the particles of sugar from the air and to dissolve the same and utilizing the water with the sugar dissolved therein in the process of making sugar.—PRODUCTION OF INULIN AND ITS HYDROLYSIS. **William C. Arsem** (assignor to **Industrial Technics Corporation,** of Schenectady, N.Y.). 1,616,164; 1,616,167; 1,616,169; 1,616,170; 1,616,171; 1,616,172. February 1st, 1927. Impure solutions containing inulin are treated with magnesium hydroxide, filtered, and precipitated by the addition of alcohol; or the juice may be subjected to the action of a mixture of calcium hydroxide and calcium chloride, and later to that of activated carbon, sodium carbonate being finally added to precipitate the lime. In hydrolysing inulin-containing solutions the action of the acid is continued until the rotation of polarized light passes through a maximum, decreases, and again increases to a further and higher maximum than that first obtained. The inorganic acid used for hydrolysis is present in the solution in a concentration corresponding to about 0·05 normality for a period of about five minutes.—PRODUCTION OF LEVULOSE. **William C. Arsem** (assignor to **Industrial Technics Corporation,** of Schenectady, N.Y., U.S.A.). 1,616,165; 1,616,166. February 1st, 1927. In hydrolysing a solution of inulin for the production of levulose, the H.I.C. is maintained approximately equivalent to 1/100th normal, and the solution kept at an elevated temperature until the desired conversion is effected. Two other claims are stated, and a "new food product comprising a solution of fructose and containing tartaric acid" is covered.—METHOD OF PURIFYING SUGAR SOLUTIONS. **William C. Arsem,** of Schenectady, N.Y., U.S.A. 1,616,168. February 1st, 1927. A method of purifying solutions containing sucrose comprises precipitating the impurities from the impure solution of sucrose by subjecting the solution to the action of a base more basic than calcium carbonate and a normal alkaline earth metal salt of an acid stronger than carbonic acid, which salt alone is capable of precipitating impurities from the impure sucrose solution, the amount of base and alkaline earth metal salt being sufficient to maintain the hydrogen ion concentration between 10^{-6} and 10^{-8} and the amount of alkaline earth metal ion being sufficient to react with all of the precipitable impurities in the solution.—PROCESS OF MAKING WHITE SUGAR. **William F. R. Murrie,** of Hershey, Pa., U.S.A. 1,615,846. February 1st, 1927. Virgin or raw sugar juices are refined by liming to precipitate organic impurities, settling the precipitated impurities, and decanting the clear juices, adding a suitable precipitant to the decanted juices to precipitate the lime and iron compounds, again settling the precipitates and decanting the clear juices, concentrating the juices, then filtering the same through a suitable filter-press and finally clarifying the juices by filtering over a carbonaceous material to remove soluble organic and inorganic matter prior to crystallizing the juices in vacuum pans.

Sugar Crops of the World.

(Willett & Gray's Estimates to May 19th, 1927.)

	Harvesting Period.	1926-27. Tons.	1925-26. Tons.	1924-25. Tons.
United States—Louisiana	Oct.-Jan.	60,584	124,447	79,002
Texas	" "	—	—	—
Porto Rico	Jan.-June	550,000	541,485	589,760
Hawaiian Islands	Nov.-June	714,000	705,350	692,804
West Indies—Virgin Islands	Jan.-June	6,000	5,664	7,200
Cuba	Dec.-June	4,500,000	4,884,658	5,125,970
British West Indies—Trinidad	Jan -June	70,000	73,561	69,628
Barbados	" "	75,000	47,535	49,315
Jamaica	" "	50,000	57,675	42,843
Antigua	Feb.-July	18,000	12,800	17,300
St. Kitts	Feb.-Aug.	14,000	16,380	15,563
Other British West Indies	Jan.-June	6,000	7,550	6,253
French West Indies—Martinique	Jan.-July	45,000	48,121	47,995
Guadeloupe	" "	35,000	32,998	39,990
San Domingo	Jan.-June	270,000	354,720	311,270
Haiti	Dec.-June	12,500	11,249	8,280
Mexico	" "	175,000	190,282	165,223
Central America—Guatemala	Jan.-June	33,000	25,151	25,562
Other Central America	" "	70,000	62,500	73,240
South America—				
Demerara	Oct.-Dec. and May-June	95,000	107,580	90,874
Surinam	Oct. Jan.	13,000	10,000	10,200
Venezuela	Oct.-June	19,000	19,000	20,625
Ecuador	Oct.-Feb.	18,000	16,976	18,700
Peru	Jan.-Dec.	275,000	265,000	310,522
Argentina	May-Nov.	475,695	395,733	246,717
Brazil	Oct.-Feb.	700,000	650,000	812,493
Total in America		8,299,779	8,666,415	8,877,329
Asia—British India	Dec.-May	3,208,000	2,977,000	2,548,000
Java	May-Nov.	1,954,957	2,278,900	1,977,490
Formosa and Japan	Nov.-June	504,000	616,584	554,473
Philippine Islands	" "	520,000	436,000	581,064
Total in Asia		6,186,957	6,308,484	5,661,027
Australia	June-Nov.	425,000	522,344	435,680
Fiji Islands	" "	85,000	70,567	100,810
Total in Australia and Polynesia		510,000	592,911	536,490
Africa—Egypt	Jan.-June	90,000	94,286	79,918
Mauritius	Aug.-Jan.	196,000	241,220	224,710
Réunion	" "	50,000	59,015	52,380
Natal	May-Oct.	216,305	214,152	143,974
Mozambique	" "	80,000	59,841	44,278
Total in Africa		633,000	668,514	545,260
Europe—Spain	Dec.-June	7,500	8,704	7,661
Total cane sugar crops		15,636,541	16,245,028	15,627,767
Europe—Beet sugar crops		6,843,590	7,440,367	7,083,068
United States—Beet sugar crop	July-Jan.	801,246	804,439	974,185
Canada—Beet sugar crop	Oct.-Dec.	28,000	32,475	36,200
Total beet sugar crops		7,672,836	8,277,281	8,093,453
Grand total Cane and Beet Sugar	Tons	23,309,377	24,522,309	23,721,220
Estimated decrease in the world's production	"	1,212,932	*801,089	*3,605,111

* Increase.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1927. Tons.		1926. Tons.
Total Receipts, January 1st to May 25th	1,291,686	..	1,596,262
Deliveries ,, ,, ...	1,252,469	..	1,415,690
Meltings by Refiners ,, ,, ...	1,214,098	..	1,306,000
Exports of Refined ,, ,, ...	34,000	..	42,000
Importers' Stocks, May 25th	154,079	..	189,228
Total Stocks, May 25th	257,667	..	366,196
	1926.		1925.
Total Consumption for twelve months	5,671,335	..	5,510,060

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR,
1925 1926, AND 1927.

(Tons of 2,240 lbs.)	1925. Tons.		1926 Tons		1927 Tons
Exports	2,185,378	..	1,751,982	..	1,517,594
Stocks	1,158,245	..	1,452,147	..	1,449,624
	3,343,623		3,204,129		2,967,218
Local Consumption	60,000	..	45,000	..	36 000
Receipts at Ports to April 30th	3,403,623		3,249,129		3,003,218

Havana, April 30th, 1927. J. GUMA.—L. MEJER

Beet Crops of Europe.

(Willett & Gray's Estimates at May 19th, 1927.)

	Harvesting Period.	1926-27. Tons.	1925-26. Tons	1924-25. Tons.
Germany	Sept.-Jan.	1,660,000	1,595,545	1,575,684
Czecho-Slovakia	Sept.-Jan.	1,050,000	1,485,031	1,411,101
Austria	Sept.-Jan.	79,498	78,145	75,443
Hungary	Sept.-Jan.	173,470	172,560	202,354
France	Sept.-Jan.	699,527	757,987	834,138
Belgium	Sept.-Jan.	230,000	332,170	400,105
Holland	Sept.-Jan.	300,000	306,083	332,723
Russia (Ukraine, etc.)	Sept.-Jan.	859,350	1,041,903	458,375
Poland	Sept.-Jan.	575,000	575,673	494,854
Sweden	Sept.-Dec.	20,871	204,500	135,270
Denmark	Sept.-Jan.	150,000	179,998	140,995
Italy	Aug.-Oct.	300,000	160,926	422,429
Spain	Sept.-Jan.	290,000	243,939	252,040
Switzerland	Sept.-Jan.	6,000	6,395	5,906
Bulgaria	Sept.-Jan.	31,485	38,000	39,758
Roumania	Sept -Jan.	162,821	115,907	86,256
England	Sept.-Jan.	151,538	51,140	23,730
Other Countries	Sept -Jan.	104,000	94,465	191,907
Total in Europe		6,843,590	7,440,367	7,083,068

United Kingdom Monthly Sugar Report.

Our last report was dated 9th May, 1927.

There has been a further set-back in price during the past month, caused chiefly by the liquidation of old " bull " accounts, and heavy short sales against Javas.

The London Terminal Market has not been so active as formerly. The liquidation of May continued right through the month, and finally finished at 16s. 5¼d. There were about 25,000 tons tendered on May contracts. A good portion of the May was transferred to August, and some to New Crop. New Crop is still not pressed for sale from the Continent, as better prices are obtainable in the New York Market. May sold from 17s. 1½d. to 16s. 7½d. to 16s. 9d. to 16s. 5¼d. August was traded in from 17s. 4½d. to 17s. to 17s. 3d. to 15s. 3d. to 15s. 7½d. October sold from 16s. 3¾d. to 14s. 6d. to 14s. 9d. December from 16s. to 14s. 4½d. to 14s. 8¼d. whilst March moved from 17s. 7½d. to 16s. 2¼d. to 16s. 5¼d. and May from 17s. 9¾d. to 16s.4½. to 16s. 8¼d. The latest prices are, August 15s. 7½d.; October 14s. 9d.; December 14s. 8¼d.; March 17s. 5¼d.

The demand for actual sugar has been disappointing; the " hand to mouth " policy is being rigidly adhered to by the trade and there have been only occasional bursts of buying. Ready Czecho Granulated has been scarce, but business has been done from 17s. 9d. down to 17s., chiefly to Continental ports. Dutch Granulated has followed closely from 17s. 9d. down to 16s. 9d. and has been more plentiful. June/August has offered about 3d. premium. American and Canadian Granulated have not been pressing, but second hand parcels continued to be sold from 18s. 7½d. to 17s. 10½d. c.i.f. White Javas have been freely offered; at one time, down as low as 15s. c.i.f., but only a small business has been done. The total sales of Javas to Europe are estimated at 140,000 tons. Spot Granulated sold from 30s. 6d. down to 28s. 9d.

Home Grown Sugars continue to be offered, the latest prices being 29s. 9d. to 30s. There are now only a few thousand tons left to be sold.

The British Refiners registered a series of reductions during the month, viz., May 20th, 3d. per cwt., May 24th, 3d. per cwt.; June 1st, 3d. per cwt.; and June 7th, 6d. per cwt. The latest prices are No. 1 Cubes 34s. 6d., London Granulated 30s. 7½d.

Raws have still been held very tightly, and Cubans have declined from 14s. 10½d. to 14s. Small parcels and cargoes have been sold between these prices, chiefly to the Continent, and San Domingos can be bought to-day at 13s. 9d. c.i.f.

Business has been done in Brown Javas at 14s. 9d. to 14s. 1½d. c.i.f., Charters have been made for 96 per cent. raws to come from the Argentine, but so far no price has been mentioned.

In America there has been an improved demand for Refined and a large business was done in Raws at a basis of $3\frac{1}{16}$ but during the last few days the price has dropped to $2\frac{15}{16}$ at which level there are sellers to-day. The New York futures market has dropped about 20 points since our last report.

With regard to the European sowings, F. O. Licht has issued a further estimate increasing his previous figures of 2,366,500 to 2,420,000 hectares. This means an increase of roughly 14 per cent. over last year's acreage.

The Cuban Crop is now practically finished, at the limited figure of 4,500,000 tons. The stocks at the Ports are 1,306,826 tons, against 1,409,101 tons last year, and the receipts to date are 3,217,165 tons against 3,597,243 tons in 1926. The President has signed a decree prohibiting grinding of the new Cuban crop before January 1st.

21, Mincing Lane,
London, E.C.3.
June 8th, 1927.

Arthur B. Hodge,
Sugar Merchants and Brokers.

THE

INTERNATIONAL SUGAR JOURNAL.

☞ All communications to be addressed to "The International Sugar Journal," 2, St. Dunstan's Hill, London, E.C. 3.

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

No. 343. JULY, 1927. Vol. XXIX.

Notes and Comments.

Beet Affairs at Home.

Elsewhere in this issue we summarize the annual reports of a number of the beet sugar companies working in this country. These all show more or less successful results from the last campaign and thanks to the financial aid of the subsidy most are enabled to make their shareholders some adequate return on their investment after a long period of waiting. What is more important they have in most cases put large sums to reserve and written down the value of their plant, so that when the days of reduced subsidy, or of none at all, arrive, the amount of capital on which dividends will have to be rated will be on the low side and there will be no need to reduce its face value by drastic methods. The profits of the best established factories of the Dutch group show a remarkable increase over the previous years ; but in view of the subsidy it cannot be suggested that they are indicative of any excessive profit where a factory works without any fiscal aid. It may be observed that the general tone of the respective chairmen of the companies is one of some quiet but nevertheless definite confidence in the future providing the growers shoulder their share of the reduced profits that are foreshadowed. What these will amount to remains to be seen, but so far we have not, it must be said, seen any analysis attempted of the factory profits in terms of the subsidy.

The Anglo-Dutch group of factories have recently announced that a site has now been secured near Bridgwater, Somerset, upon which a factory will be erected for the reception of a 1928 crop provided that farmers will undertake to grow the necessary acreage under the terms of the beet contract to be agreed between the National Farmers' Union and the beet sugar manufacturers. The question of another factory, in the south of England, is also under consideration on the same basis. So far a canvass of farmers in the West of England has resulted in about 10,000 acres being promised, which should suffice for one factory as a start.

Lord Weir on Home Beet Sugar Prospects.

In the course of his annual speech as chairman of the Anglo-Scottish Beet Sugar Corporation, Lord Weir gave expression to his confidence in the future of the beet sugar industry in this country. "As a result of our experience (he said), we have no hesitation is saying that the Government policy

of substantial encouragement granted to the development of an entirely new British industry is being rapidly justified. With very little support or encouragement from normal financial circles sufficient private enterprise has been forthcoming to build factories capable of producing during the coming campaign approximately 240,000 tons of sugar, or 12½ per cent. of our total national requirements. Well over 200,000 acres of sugar beet will be grown in Great Britain this year, involving a distribution of well over £6,000,000 to British farmers. The costs of factory production are coming down. The essential technical experience of British personnel is being rapidly acquired, while on the agricultural side costs of growing beet per ton are also being reduced, and continuous progress is being made in bringing up the sugar yield per acre, this being the main factor on which the future of the industry must be based. The first reduction in the subsidy rate, which will commence to operate in the campaign of 1928-29, bids fair to be shared equitably between the growers and the factory, and still to leave both in a satisfactory financial position."

The Louisiana Flood Damage.

The impression created in this country of the extent of the flood damage in Louisiana, based on the brief telegraphic reports, has fortunately proved above the mark. As will be seen in the brief reference to the subject made by Mr. A. H. ROSENFELD in his interesting paper on the Present Status of the Louisiana Sugar Industry, which we give elsewhere in this number,[1] the greatest flood in the history of the Mississippi, even though it has overflowed vast areas of new Java canes, has missed enough of the POJ 234 to allow at least 100,000 acres of this cane to be laid down for 1928. Other reports incline to the view that as much as two-thirds of the POJ cane will be saved, due to the fact that the flood water failed in the end to reach the heights at first forecast when the Red River was breached in several places. Sand bars formed in several places and diverted the water, and the result was that in some places the plantation owners were given just sufficient time and encouragement to erect protective levees that kept the water at bay and reduced the area submerged. This news that the new Java seedling cane has in large part escaped destruction will put some heart in an otherwise thoroughly disheartened planting community. On the other hand, the destruction by flood of the older plantings may in the end prove the needed incentive to many planters to make the change to the newer varieties, and in that event, to paraphrase a well-known saying, it will be an ill flood that bodes no good.

In his paper above referred to, Mr. ROSENFELD sketches the conditions to which the Louisiana sugar industry has brought itself and indicates what he considers the principal causes for the decline. The sugar crop of this southern American tract has dropped to the lowest figure in over 50 years, and of late years with two exceptions—1921 and 1922—yields have been slowly but steadily declining until they have reached almost vanishing point. In 1926 fifty-four factories produced but 47,166 short tons of sugar. The principal cause of the decline is the spread of mosaic disease in the susceptible Cheribon (La. Striped and Purple) and D 74 canes that have formed for generations the main basis of Louisiana sugar production. This spread of disease has been heightened in Mr. ROSENFELD's opinion partly by the persistent custom of selecting for seed the unfittest cuttings instead of the best cane, and also of planting corn amidst cane plantations, inasmuch as corn is the pre-

[1] Page 356.

ferred host plant of the aphid transmitting mosaic disease. The remedy is of course to plant varieties immune to, or at least tolerant of, the mosaic, and the experience of both Argentina and Porto Rico has pointed to Java POJ seedlings as the most likely ones to achieve that result Three POJ varieties have been sufficiently tried so far in Louisiana as to warrant commercial application, viz. Nos. 36, 213 and 234; and they have shown themselves possessed of other attributes than that of resistance to mosaic, resistance to cold weather being one. Mr. ROSENFELD is optimistic as to the outlook when these canes have been fully substituted for the older degenerate stock, and in view of the fact that they have seemingly saved enough seed cane for 100,000 acres, it would appear that the setback to the Louisiana industry through the floods will not include this very important factor of seed supply; the outstanding difficulty will in all probability be the question of financing the next crop, and here it is reasonable to suppose the Federal Government will render assistance.

The Jamaica Crop.

The present season, according to the *Jamaican Gleaner*, is proving a better one for that island's sugar crop than was 1926. The export price for refined crystals in May was £16 5s. per ton, which compares with £13 15s. to £14 in May 1926. The demand for sugar is not unsatisfactory, 29,559 tons of sugar having been exported up to 21st May last, as against 26,371 tons for the same period of 1926. This year's total production is expected to amount to 65,280 tons of sugar and 12,580 puncheons of rum, which compares with last year's outturn of 56,155 tons and 15,699 puncheons; in all 40 estates are working.

The year 1926 was in fact a disappointing one for Jamaica sugar producers owing to the extremely low world selling price. The Jamaica Sugar Estates Ltd., which has just recently issued its report for the 12 months ending August 1926, its first year of operations, has had to face a net loss of £40,711. This is attributed not only to the extremely low price of sugar but also to a low factory output due to a shortage of cane, while at the start considerable trouble with the labour supply was experienced. For the current season matters have improved both in respect to price and to the turnover of the factory

The Caroni Estates, Trinidad.

At the fourth annual general meeting of Caroni Sugar Estates (Trinidad), Ltd., in June, Mr. J. GORDON MILLER (the chairman) said 1926 had proved to be another difficult period for producers of West Indian crystallized sugar. It rivalled 1925 in market fluctuations, involving highest and lowest prices with a difference of as much as £10 per ton. At the end of the previous accounting year overdraft from the bank stood at £56,689, but they were in funds to the extent of £28,632 on December 31st, 1926. Stock of produce held at that date was valued at £27,240. There was still a balance of old crop sugar unsold, but it moved off steadily at full prices, and their forward sales of new crop were at better values than twelve months ago. Profit was small, and did not admit of any further allocation to the depreciation account; but properties and plant had been well kept up, and were in good condition. The balance to credit of profit and loss account was £7,203, after making provision for charges subject to liability for taxation of £5,500, but certain relief, it was hoped, would reduce the sum to be paid. The quantity of sugar produced was 8675 tons. Their principal trouble on the Caroni Estates had

been the froghopper pest, and the resultant under-production. But for this and the blight which followed infestation the present position of the estate would be greatly improved. A conservative estimate of the loss on their two estates during 1926 and 1927 due to this pest was at least 4000 tons—an equivalent in value of two years' preference dividend. The one consolation in the outlook for 1928 was the probability that there would this autumn be a comparative freedom from the pest ; and prospects for a bumper crop next year were exceedingly good. For the present season practically all the sugar estates in Trinidad had been fully one-third short of their estimated crops. Actually, the weight of cane per acre was up to estimate, but the sucrose content of juice was exceptionally low. Caroni expected to show a profit for 1927, but the unknown quantity was the cost of production, bound to be higher owing to the small tonnage. They had this year had two months' drought in the wet season, then the froghopper pest, then persistent rains and floods during the dry season, all of which had adversely affected the output.

Colonial Sugar Producers and Refining Interests.

Mr. MILLER had something to say on the lack of direct interest in colonial raw sugar factories by British refiners. Neither British nor Canadian refining houses hold any direct interest in West Indian sugar production. On the other hand, the United States investment in Cuban sugar production is probably 75 per cent. of the whole ; while American refining interests control close upon 50 per cent. of the total production. That is apart from American interests in Hawaii and the Philippines. It is a matter for regret, and surely one for careful investigation, that no serious attempt has been made to link up more closely the raw sugar producers in the Colonies and the refining interests at home. Direct production of plantation white sugar by new processes is increasing in all countries, and it is quite conceivable that the supply of raw sugar will show signs of a steady decline. The manufacture of plantation white sugar is a seasonal business, and it is claimed that, by working all the year round in a home refinery, it is possible to refine imported raws economically and cheaply, notwithstanding freight and handling charges. It would seem reasonable that in the interests of the United Kingdom and the Colonial producers, every avenue should be explored, not only by the trading interests, but by the Government, to assure the fullest development and interchange of this great commodity within our own Empire.

Mr. MILLER pointed out how any such development of co-operation might affect Trinidad. In the central and northern parts of the island of Trinidad, there are, at present, five separate companies dealing with six factories, each of a producing capacity of from 4,000 to 12,000 tons. These Trinidad concerns, had they been working under amalgamation, would certainly have effected very considerably savings for their shareholders. There is no industry which presents less difficulty, and lends itself more easily to a scheme of amalgamation and grouping of factories, than Sugar. Therefore, in his view, one should concentrate upon field research, intensive cultivation and production to the maximum capacity of economical central factories.

The Trinidad College.

According to a Trinidad correspondent of the *Times*, Mr. GEOFFREY EVANS, C.I.E., acting Principal of the Imperial College of Tropical Agriculture in Trinidad, has come to England to confer with the Governing Body on

important matters affecting the administration of this college. In his absence, and until the appointment of a successor to Dr. MARTIN LEAKE (who has retired), Professor BALLOU will act as Principal. In the last twelve months there has been marked progress in the development of the College, and the work accomplished during the last academic year has been highly satisfactory. The College sugar factory has had a successful season, crushing about 1200 tons of cane. Owing to abnormally wet weather, there were special difficulties to contend with, but these were successfully overcome, and an elaborate programme of research has been carried through. The students who have taken sugar technology have received an excellent training, since opportunity has been taken of the remarkably complete and up-to-date machinery at the factory to experiment in the making of all kinds of sugar. Four diploma students are leaving the College this year. Two of them are taking up positions as sugar technologists in British Guiana, and the other two have accepted positions at the Usine St. Madeleine, the largest sugar factory in Trinidad.

The League of Nations and Sugar Production.

At the International Economic Conference of the League of Nations held in Geneva this summer, the Cuban delegates submitted some observations regarding the present position of sugar from the international point of view. Their statement is given in full in a recent copy of Willett & Gray's *Sugar Trade Journal*, and may be summarized as follows.

Sugar is a commodity of which a greater supply than that required to satisfy the demands of international trade is almost constantly being produced. There is a general tendency to produce in excess, and it is stimulated almost everywhere by high protective duties, by colonial preferences, and in some cases by bounties. But notwithstanding this artificial stimulation, which creates an almost constant world surplus, the consumption of sugar is very substantially reduced and restrained in a good many countries by high internal taxes.

Protective tariff rates on sugar, especially when domestic consumption is restricted by internal taxes, have the effect of causing production to exceed the domestic requirements, which leads to an expansion into foreign markets. The customs duty in such cases, therefore, acts as a bounty to promote surplus production, leading to enforced exportation and dumping in foreign countries. There exists therefore an evident maladjustment and waste from the economic standpoint, production being stimulated while consumption is restricted, in both cases from the extreme fiscal policies so generally applied to sugar.

The Cuban delegates therefore urge that the international sugar industry should strive for the following ends : (1) That protective measures as applied by particular countries to sugar should be limited to assuring supplies for the domestic markets and should not stimulate surplus production for foreign markets which generally leads to dumping. (2) That countries which stimulate sugar production by fiscal means should not at the same time restrict the internal consumption by means of taxes, for it is only by permitting consumption to take place freely in the domestic market that a policy of artificial stimulation of production can be justified from an economic standpoint. (3) That in the interests of increased consumption of sugar as a food, all associations of producers endeavour to create, by means of an educational campaign, a state of opinion unfavourable to excessive duties and taxes on sugar, and bring about gradually a uniform classification of sugar in the tariffs and customs

regulations of the various countries. And (4), that the associations of producers in the leading exporting countries combine in an effort to increase and expand consumption, principally in undeveloped markets, and for this purpose enlist the co-operation of the sugar-using trades ; agitate for cheaper transport rates and facilities ; make efforts to remove obstacles and onerous conditions interfering with the trade ; agree upon standard and uniform grades, classes and containers for the export of sugar ; and, if possible, organize an international export and distributing corporation, to sell co-operatively in such markets as may be determined on.

The delegates add that the President of Cuba is taking steps to hold an international conference of the sugar producers of the world, which it is expected will meet in Havana in the near future, and at which there will probably be the opportunity to consider the above suggestions in all their ramifications.

The Seaports of Cuba.

In a recent issue of *Commerce Reports* a detailed account is given of the various seaports of the island of Cuba, from which the following particulars may prove of interest. Cuba has a coast line over 2000 miles in length and is remarkable for its large number of capacious harbours, roadsteads, and excellent anchorages. Most of the harbours are pouch-shaped inlets, indenting the coasts, with narrow outlets giving access to the sea. The island averages only 60 miles in width and no place is more than 40 miles from the sea, consequently no place is without nearby export facilities.

According to a Law promulgated in 1923 the handling of the foreign commerce of Cuba is restricted to certain designated first-class ports, but there is a proviso that the sugar centrals and entities which had constructed and used private ports or wharves prior to the enactment of this law can continue to use them for the same purpose. Havana outranks all other ports in the volume of imports, handling over two-thirds of the total ; Santiago de Cuba ranks second, followed by Cienfuegos, Nuevitas, Matanzas, Nipe and Caibarien. The export trade, on the other hand, is more evenly distributed as might be expected. In years when sugar prices are low Havana stands first, but ordinarily it is outranked by Nuevitas. After them in importance come Cienfuegos, Nipe, and Matanzas.

HAVANA ships practically all Cuba's tobacco exports in addition to large quantities of sugar, molasses, fruit and vegetables. The harbour is in a landlocked bay ; the dock facilities comprise over 40 wharves completely encircling the harbour, the main portion of which is dredged to a depth of 36 feet. SANTIAGO DE CUBA on the south coast is the principal seaport of Eastern Cuba and has a landlocked harbour six miles inland, the narrow entrance to which was the scene of the exploits of HOBSON and the "Merrimac" in the Spanish-American War. NUEVITAS, on the north coast of Cuba lies on Nuevitas Bay. It is said to be the world's leading sugar port, exporting more than twice as much sugar as any other port in the world. The harbour itself is several miles inland and is large and completely sheltered ; it consists of two terminals about three miles apart, each serving a railroad. The latest wharves are of concrete and have special facilities for loading sugar and molasses. CIENFUEGOS on the south central coast is the most important export centre on that side of the island. It lies in a landlocked bay which provides a first-class harbour. NIPE BAY on the north-east Coast is said to be one of the largest deep water harbours in the world. It also is landlocked and affords a safe anchorage for the largest vessels. It is the north coast terminus of the

Cuba Railroad and exports principally sugar. Another sugar exporting terminal is GUANTANAMO BAY on the south coast near the eastern extremity of Cuba. The bay is 11 miles in length and consists of an outer and an inner harbour, admitting the deepest draft vessels. Altogether, it will be seen, Cuba is exceptionally endowed with good harbours, which greatly facilitate its huge annual shipments of sugar.

Annual Reports of United Kingdom Beet Factories for 1926-27.

CANTLEY.

The third annual general meeting of the ENGLISH BEET SUGAR CORPORATION LTD., which owns the Cantley factory, and also works by arrangement the Kelham factory of Home Grown Sugar Ltd., was held at the end of June.

The Cantley factory, according to the directors' report, has worked satisfactorily during the past manufacturing season. The quantity of beets worked up amounted to 161,841 tons, as compared with 127,319 tons in 1925, an increase of 27 per cent. The average daily tonnage was 1383 tons, and as this represents the maximum capacity of the factory, further expenditure is being incurred this year to increase the seasonal capacity to 200,000 tons. Contracts were made with 2936 growers for 21,820 acres of roots, which compares with 2344 growers and 15,897 acres in 1925. The average sugar content obtained was 18·05 per cent., as against 16·73 in 1925; the average price paid to the growers for their beets was 61s. 9d. per net ton or 11s. 4d. in excess of the statutory minimum. In the previous season the figure was 57s. 3d.

Thanks to the better quality of the beet crop and to the improved prices obtained for sugar produced, the profit on trading amounted to £306,949, compared with £184,058 in 1925. For the fourth year in succession the Company operated the Kelham factory; this latter made a trading profit of about £227,157, of which 30 per cent., or £68,147, was taken by the English Beet Sugar Corporation.

After providing for all charges, for income tax, and for depreciation, and after transferring £156,067 to General Reserve, a balance of net profit of £90,101 has remained, out of which the preference and ordinary shareholders have received a dividend of 20 per cent. free of tax (equivalent to 25 per cent. cum tax). In deciding on this dividend the directors have borne in mind the long years during which the shareholders received no return on their capital. The financial position of the Company is now good, there being a general reserve equal to 60 per cent. of the issued share capital, while about 30 per cent. has so far been written off the original value of the plant and buildings. On account of this conservative policy which will be continued in coming seasons, the directors view with equanimity the impending decrease in the subsidy (1927-28 being the last season in which the full subsidy will operate).

ELY.

At the third annual general meeting of the ELY BEET SUGAR FACTORY LTD., held last month it was stated that the Ely factory had worked satisfactorily during its second manufacturing season in 1926-27. In 1925, the year the factory was built, 80,179 tons of roots were worked. Last season

this was increased to 188,800 tons, or 135 per cent. more. The average amount of beets worked up daily was 1764 tons. Beets were supplied by 2531 growers from 17,637 acres, which compares with 1179 growers and 5941 acres in 1925. The average sugar content was 16·17 as compared with 15·27 in 1925. The growers received for their roots an average of 57s. 1d. per net ton, or 11s. 5d. per ton in excess of the minimum price laid down in the British Sugar (Subsidy) Act, 1925.

The trading profit amounted to £307,540, which after providing for all charges, for debenture interest, for income tax, and for depreciation, and transferring £60,423 to general reserve, yielded a net profit of £56,250. Out of this the directors have paid a dividend upon the ordinary shares of 12½ per cent. free of tax (equal to 15⅝ per cent. cum tax).

At the date of the previous annual meeting the issued share capital was £250,000, and there was an issue of debentures amounting to a further £100,000, while an unsecured cash liability existed, amounting to £221,115. Since then a further issue of £200,000 in fully paid shares has been made at 23s. per share, and the proceeds of this have allowed the unsecured loan to be repaid. In addition, it is announced that since the present accounts were made up, the debentures have been repaid in full.

The Chairman (Sir JAMES MARTIN) pointed out that while the past season has witnessed a favourable harvest and a steady sugar market, it must not be forgotten that the factory and the farmers combined have to contend against Nature in unfavourable seasons, and the factory by itself has to bear the risk of a falling sugar market. The factory to date has cost £647,880, but £129,576 of this has been written off to date, while there is a general reserve of £66,490.

IPSWICH.

The third annual general report of the IPSWICH BEET SUGAR FACTORY LTD., showed that the Company's factory at Ipswich has also worked satisfactorily during its second manufacturing season. In 1925, the year it was built, 21,088 tons only of roots were worked up, the factory being closed before the end of the season on account of irregularity of deliveries due to frost, the remaining beets being sent to other factories. But this last season a full campaign was worked, and 137,966 tons of beets were treated, the average daily throughput being 1179 tons. Contracts were made with 944 growers for 8856 acres, while a further supply from 6393 acres in the Yeovil district in the West of England was accepted and worked up. The average sugar content was 18·05 per cent. compared with 17·43 in 1925. The corresponding figures for 1925 were 4059 acres and 658 growers, with 793 acres grown by 293 farmers in the Yeovil district. The average price paid to the growers was 62s. per net ton, or 11s. 8d. per ton in excess of the statutory minimum price.

The trading profit amounted to £287,232; and after providing for all charges and for depreciation, and after transferring £67,391 to General Reserve there was a balance of net profit of £50,000, which has been applied to paying a dividend on the ordinary shares of 12½ per cent. free of tax (15⅝ per cent. cum tax). This year £96,112 has been put to depreciation account, and the factory property, which cost to date £500,405, now stands in the balance sheet at about £100,000 less, while the reserves now stand at £91,334, representing 23 per cent. of the Company's issued capital of £400,000. A year previously the issued share capital was £250,000, and there were debentures for £100,000 and an unsecured cash liability out-

standing of £170,097. During the year a further £150,000 in fully paid shares was issued to the public at 23s. per share. This enabled the unsecured loan to be repaid in full, and since the date of the present accounts the debentures also have been repaid in full, the holders having waived their premium rights.

In his speech at the general meeting, the Chairman (Sir G. L. COURTHOPE, M.P.) stated that owing to the above mentioned consolidation of the financial position of this Company, the directors have no fear that the declining rate of subsidy will necessarily have a serious effect upon the beet sugar industry in this country which has saved so many farmers from financial disaster. It is true that the reduction after 1928 will be relatively substantial, but provided that the factory and the farmer share equitably in the fall of the subsidy there is no reason for any loss of confidence either in the Company or in the industry generally. The policy of the factories will be a continual attempt to accumulate experience and reduce costs at a rate which, with the co-operation of the grower on similar lines, may adequately meet the decline, and ultimately the cessation, of the subsidy.

KIDDERMINSTER

The second annual general meeting of the WEST MIDLAND SUGAR COMPANY LTD., the owners of the Kidderminster beet sugar factory, was held at the beginning of July, when a maiden dividend of 7½ per cent. was recommended. According to the statement of the Chairman (Lord WEIR), the results of the year ended last March fully bore out anticipations of a reasonably profitable season. The quantity of roots dealt with amounted to 54,832 tons, which was about 10 per cent. in excess of the normal rated capacity of the factory and compared with 28,858 tons in the previous campaign. The average sugar content was 17·8 per cent. (against 17·2); the acreage cultivated was 6,127, distributed amongst 1,348 growers, to whom the average price paid worked out at 59s. 9d. per ton, or 15s. 9d. per ton in excess of the statutory minimum.

The manufacturing profit of the factory was £107,457, and the net profit after writing off preliminary expenses (£23,640), providing £15,000 for depreciation, and making provision for all trading charges and for income tax, was £44.232. To this had to be added a balance of £2,126 carried forward from the previous year, making the credit of profit and loss account £46,358; of this sum £10,800 is absorbed in payment of the dividend of 7½ per cent., and the balance of £35,558 is carried forward.

For the ensuing campaign Lord WEIR said the outlook was good. The output capacity of the factory is being doubled to deal with 1000 tons of roots per day, the cost being met without any further issue of capital; and the acreage of beets is ample and only needs a spell of sunshine in its later stages to produce a good crop. On the agricultural side costs are steadily decreasing with increased experience; and taking all considerations into account the directors of this company have no apprehensions whatever of any serious influence likely to imperil the successful financial future of either the factory or the growers.

COLWICK AND SPALDING.

The third annual general meeting of the ANGLO-SCOTTISH BEET SUGAR CORPORATION, LTD. revealed satisfactory progress for 1926-27 in the operations of the Colwick and Spalding sugar factories. Lord WEIR (the Chairman) said that the total tonnage of roots dealt with was 135,022 tons from 16,100 acres worked by 4,003 growers. Colwick's average sugar content was 17·32

and Spalding's 16·65. The average price paid to growers per ton was 58s. 4d., or 14s. is excess of the statutory minimum.

The trading profit from the two factories was £158,992. A sum of £46,000 is placed to depreciation reserve, interest on loans and debentures absorbs £33,900, and with certain other deductions, the net profits amount to £63,119. In view of the expansion programme of the company, no dividend is declared, £17,050 being written off for preliminary expenses, etc., and £46,069 carried forward, subject to directors' fees.

The balance sheet shows that £16,873 has been expended during the year on additions to the factories, and the present value of the two plants, less depreciation account deductions, amounts to £782,465. The investments in associated companies have been increased by the sum of £228,000, representing the ordinary share capital of the Second Anglo-Scottish Beet Sugar Corporation, the company responsible for the new Felstead, York and Cupar factories. To provide for this there was issued during the year £240,000 five per cent. Second Mortgage Debenture Stock guaranteed by H.M. Treasury and £140,000 five per cent. Twelve Year Notes.

Progress during the year under review has been fully satisfactory ; the quality of the beet was high, sugar prices were good ; but, on the other hand, the campaign represented Spalding's first year of operation with the usual preliminary troubles, and both factories suffered from bad and expensive fuel due to the coal strike, Colwick in particular. Spalding factory is now to have its capacity doubled at a cost of some £90,000. With regard to the present season, it is too early to prophesy with certainty, but the recent rains have vastly improved the prospects of the crop, and given now a reasonable amount of sun the crop should be satisfactory. The acreage of this company and of its subsidiaries has grown from 3,950 in 1924 to 65,310 in 1927.

It should be observed that this parent company has in the year 1926-27 carried through the financing and erection of three entirely new factories, and has operated in the one season for the first time four new ones, so the financial results do not represent a normal year of established working. Next year it is hoped that the dividend paying stage will be reached ; but as the company is working with a small ordinary share capital and a high proportion of loan capital, the prior charges are disproportionately large.

York, Felstead, and Cupar.

These factories, run under the auspices of the Second Anglo-Scottish Beet Sugar Corporation Ltd., are all new factories in new areas, and in their first year, working at capacities much below their normal rating, earned a manufacturing profit of £70,739. Of this, £29,715 was due for interest, £17,500 was placed to Depreciation Account, £6000 to reserve for Income Tax, and, of the net balance of £17,524, a sum of £14,049 was written off for preliminary charges, and £3475 carried forward. For the coming campaign both Cupar and Felstead factories are to be doubled in capacity at a cost of about £90,000 each.

Mr. F. O. Licht, at June 30th, estimated the European beet sugar area at 2,482,000 hectares, compared with 2,420,000 hectares a month before and 2,171,000 a year ago. The estimate includes Holland at 69,000 hectares and Russia 640,000 hectares; the latter area was only 543,000 hectares a year ago.

The Present Status of the Louisiana Sugar Industry.

Thoughts on Some Causes of Current Conditions, and Possibilities of Improvement.

By ARTHUR H. ROSENFELD,
Consulting Technologist of the American Sugar Cane League.

When the sugar crop of any country or any section drops to the lowest figure recorded in over fifty years, despite the added knowledge of both field and factory practice which should have vastly increased yields during that half century, it is perfectly evident that there is something most radically wrong somewhere. The last report of Mr. LIONEL L. JANES, Agricultural Statistician of the Bureau of Agricultural Economics, under date of May 24th, 1927, shows that the Louisiana sugar crop for 1926 was but 47,166 short tons. This handful of sugar represents the output of 54 factories. To find any comparable crop we must hark back to the year 1873 when, in what we are inclined to consider those benighted days, 1181 factories in Louisiana turned out 46,078 tons of sugar. From 1894, in the 20-year period prior to the beginning of the World War, Louisiana contributed to the world crop of sugar, which was then of course much smaller than now, an average of around 250,000 tons of sugar per annum. In the past decade, with the exception of the two favourable years of 1921 and 1922, yields have been steadily but surely declining until they have reached almost the point of disappearance shown by the crop of 1926. The following table shows the sugar produced in long tons during the past decade and the number of factories turning out the crop each year.

LOUISIANA SUGAR PRODUCTION, 1916-26.

Year.	Number Factories.	Sugar Produced. (Tons of 2240 lbs.)
1916	164	271,339
1917	162	217,499
1918	169	250,802
1919	145	108,035
1920	122	150,996
1921	124	289,669
1922	112	263,478
1923	105	144,663
1924	82	79,003
1925	91	124,448
1926	54	42,112

Of course in examining what we consider the main causes of this drop in production we must admit at the outset that climatic conditions, such as drought, excessive rainfall, floods, early frosts, and even cyclones, have all had their effect, but we must also realize that, taken in cycles, in previous periods, when Louisiana was producing excellent crops, all these factors also entered into results. Climates do not rapidly change and almost all favourable and unfavourable factors will generally about average themselves if we take 10 or 20-year periods as our basis of calculation. Undoubtedly, also, there have been some cumulative effects of weakened soil conditions, physically, chemically and biologically, which have been accentuated to some extent during the past three years of disastrous crops, when the amount of fertilization was undoubtedly considerably reduced; rotation with legumes was not as general as when money was being made which could be devoted to this necessary factor in Louisiana cane culture, and there can be no argument that drainage has not been as efficient in general during these last few years. But these factors are all accessory rather than the principal

ones leading to our present conditions, and the writer does not propose to consider them in the following brief and superficial examination of what he considers the main factors in producing present day small crops of sugar in Louisiana.

Mosaic Disease.

As a matter of fact, we are comparatively safe in saying that there is one principal cause of present Louisiana conditions, and that is the effect of the spread of mosaic disease on the susceptible Cheribon (Louisiana Striped and Purple) and the D 74 canes, which have formed for generations the main basis of Louisiana sugar production. The writer does not in the least wish to minimize other factors, particularly what is known as the root disease complex and the effects of certain soil animals, such as snails, centipedes and nematodes, but he does maintain that even these agencies have been enabled to vastly increase their sphere of injury through the weakening of the plant and its roots by the attacks of the mosaic disease. Stating the case in another way, we might say then that our varieties commonly cultivated in Louisiana have been at fault since they have had their vitality reduced, year by year, in increasing degree, by the insidious attacks of the mosaic disease virus, and thus weakened in their resistance, have fallen prey to the *coup de grâce* by organisms which ordinarily would have had very little or at least considerably less deadly effect on them.

Varieties of Cane.

The question of obtaining and propagating varieties either immune to, or tolerant of, this dread disease has become logically (in view of the successful results accomplished in other countries, notably Argentina and Porto Rico, along the same line) the phase of the problem on which our main efforts must be bent. Large numbers of such resistant types of cane have been tried out both at the Louisiana Experiment Station at Baton Rouge and by the officials of the section of Sugar Plant Investigations of the United States Department of Agriculture—trials which have been followed and co-operated in with avid interest by members of the American Sugar Cane League and the planters of Louisiana in general. At present we have released, as definitely suitable canes, the three POJ varieties with which victory in similar fights was obtained in both Argentina and Porto Rico. These are the POJ 36, 213 and 234, of the latter of which there will be sufficient seed this fall, even despite the vast areas of new canes which have been overflowed by the greatest flood in the history of the Mississippi, to lay down at least 100,000 acres for next year's crop. Once we have the cane area of the State growing varieties of cane which are highly resistant to the disease which is the principal cause of Louisiana's present difficulties, we will be in a better position to study and minimize the effects of other troubles, such as root disease, soil organisms, improper drainage, deficient rotation, etc. At Baton Rouge, Doctors Edgerton and Taggart have done some excellent work along the line of selecting disease-tolerant strains within the D 74 and Purple canes. The results attained have been quite remarkable and there seems every reason to believe that the same principle of selection, applied to the new amd more tolerant canes, should result in increasing the vigour of these canes to an equal degree. We do not feel, however, that the present problem can be met through the selection of disease-resistant types in the old varieties, as the process is too slow and our condition too acute. We are rather inclined to agree with Mr. A. F. Bell, one of the three travelling research scholars sent abroad by the Department of Agriculture of Queensland, who visited

Louisiana last year. Mr. Bell concludes, in reporting this interesting work,[1] as follows : "It could not be said that this experiment shows any great promise, and it is apparent that any relief must come from the new resistant varieties."

Fortunately the POJ varieties, 36, 213 and 234, have other qualities besides their disease resistance, which makes it appear that they are better adapted to our sub-tropical climatic conditions than the Striped, Purple and D 74 at their best, and before there was any infection of mosaic disease. One important point in this regard is their deep and well developed root system, which makes them far more resistant to the attacks of the root disease complex and to soil animals. Probably of equal importance in Louisiana is their increased resistance to cold weather. An excerpt from an article by Dr. W. E. Cross, Director of the Tucuman Agricultural Experiment Station in Argentina, in the sugar district of which climatic conditions are very similar to our own soil, well covers the importance of this point.[2]

"The mosaic-resistant canes now commonly cultivated in Tucuman, POJ 36 and 213, are also more resistant to frosts than the Striped and Purple. This, I think, is a fact well established in this country. It can be noted most frequently right on the lands of this Experiment Station, where the distinct varieties which are cultivated alongside of each other are exposed to our almost annual frosts. As an additional proof it might be interesting to cite an experiment carried out at this Experiment Station in 1920. In that year we still had a large number of varieties of cane standing when some unusually heavy frosts occurred, and when the following minimum temperatures were experienced :—

Date.	Degrees Centigrade.	Approximate Fahrenheit Equivalent.
July 9	—1·5	29·3
July 13	—4·2	24·3
July 14	—4·0	24·8
July 15	—3·5	25·7
July 16	—1·5	29·3

"Besides standing these low temperatures, the cane also had to undergo a snowfall which entirely covered the ground with a white blanket for several hours on the morning of the 13th of July. In this experiment a number of varieties of cane were left standing after these frosts until spring. The following table indicates the results obtained upon analysis :—

Variety.	Date of Analysis.	Brix.	Sucrose.	Purity.
La. Purple	23rd September	9·65	5·00	51·81
La. Striped	,, ,,	11·51	7·94	68·98
POJ 36	7th October	15·77	13·39	84·90
POJ 36	21st October	14·71	12·77	86·81
POJ 36	4th November	11·53	9·61	83·34
POJ 213	7th October	14·27	11·80	82·69
POJ 213	21st October	13·01	10·18	78·24
POJ 213	4th November	11·35	8·5	74·88

"The great contrast between the old canes and the new cannot fail to be appreciated on studying these figures."

In explanation of this table, it must be remembered that the Argentine seasons are just the reverse of ours ; hence their October corresponds to our

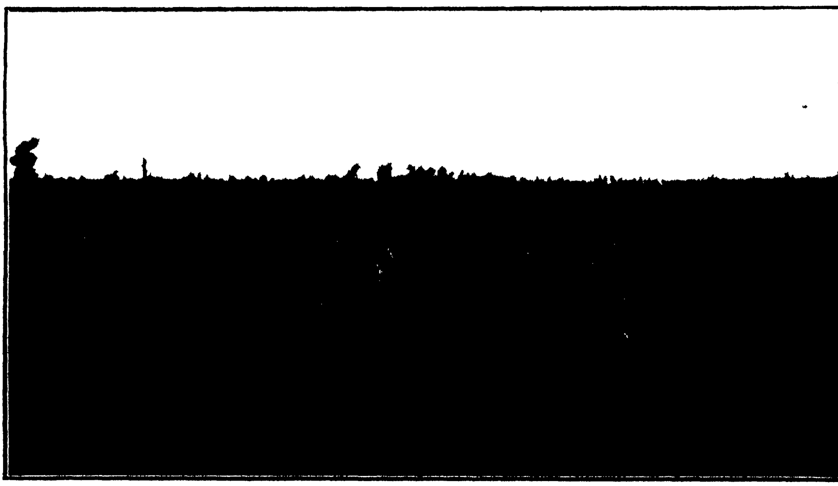
[1] Bell, A. F.—Report to the Director of the Bureau of Sugar Experiment Stations of Queensland, Australia, on Cane Diseases of Louisiana and the West Indies. 1926.

[2] Cross, W. E.—La Importancia de la Enfermedad del Mosaico en Louisiana. *Revista Industrial y Agricola de Tucuman*, Vol. XV, pp. 22-8 ; 1924.

April, and November to our May. What would we think in Louisiana of cane which had gone through frosts around 24° plus a snow-storm in January, showing above 86 purity in April and still above 83 in May ?

SEED SELECTION.

As stated above, while the one principal cause of the present minimum yields of cane in Louisiana can be ascribed to mosaic disease, there can be no doubt that the persistent selection of the unfittest for seed of the old varieties in Louisiana during the past century has materially weakened the stock, and thus made it a far easier prey to the ravages of the mosaic disease than would otherwise have been the case. The term "degeneration of sugar cane" has been rather loosely used in the literature of late years, but the writer feels that it is in just such a case as this, where the poorest cane has been propagated year after year, that genuine physiological degeneration can and does occur. Even during the past three disastrous crops when both the State Experiment Station and the Federal agricultural



A GOOD STAND OF YOUNG PLANT CANE.

authorities were vigorously calling the attention of the planters to the necessity of selecting their best cane, such as it was, for planting the following crops, the writer has repeatedly seen cane which the owners frankly admitted was not worth grinding, put down for seed—in dozens of cases where the amount of seed produced per acre was not sufficient to plant an equal area. It is a strange fact that, as far advanced as Louisiana has been in her general agricultural practice, this fundamental factor in maintaining proper sugar cane yields has not only been ignored but the antithesis of the old theory of seed selection has been fairly generally practised. The writer has no hesitancy in stating at this juncture that, with the new POJ cane or with other even superior canes which we trust will be evolved as the varietal work goes on, unless more rational, yes elemental, selection of planting stock is carried out he feels that it will be but a comparatively few years before the new canes will have their disease resistance so reduced as to fall prey to some similar ailment as is now decimating the sugar areas of the Pelican State.

Planting of Corn on Cane Plantations.

Mr. Bell, in the report previously referred to,[1] makes the following observations on this point :—

" The reason for the rapid and complete spread of mosaic in Louisiana is attributed to the practice of farmers of growing about half cane and half maize, and interplanting corn and cane in comparatively small fields. Owing to the low value of sugar, it is unlikely that the farmers will be persuaded to give up the growing of maize, and this will be an ever present force militating against complete control of the mosaic in cane."

The question of the advisability of discontinuing the growing of corn on Louisiana plantations is a much mooted one, and one which rather distinctly affects the sensibilities of many of our planters when brought under discussion. From an agricultural as well as a commercial standpoint, however, there seems no logical refutation of the opinion of many persons well authorized to speak on the matter, that corn is an economic misfit in plantation practice in the State. From the commercial standpoint it does not seem practicable simply because it does not pay, for corn yields are generally small in the sugar district and in most years corn can be purchased on the open market cheaper than it can actually be produced on the plantations. Many of our planter friends will reply to this argument that at least the corn which they plant with the soy beans, which are later to be turned under as green manure, costs them nothing to cultivate, as they would have to cultivate the beans anyway. The best argument against this point of view, however, is that, entirely aside from the fact that corn is the preferred host plant of the aphid transmitting mosaic disease, the moth stalk borer (*Diatraea saccharalis*) and rough headed corn stalk beetle, *Ligyrus rugiceps*, (as well as harbouring other insect and fungus pests which attack cane) it would seem to be *poor business* to plant in a rotation a crop closely related to sugar cane and drawing on the soil for almost exactly the same type of plant food as we are trying to restore to our soils through rotation with legumes. The presence of corn in the fields of legumes frequently prevents these legumes being turned under at the stage when their turning under would give the maximum benefit, chemically and physically, to the soil, and it would certainly seem logical that, using the same food elements as the cane, even in the fields of soy beans, the corn is removing from the fields in rotation much plant food which would be more valuable to the following cane crop than the value of the light crops of corn. The rôle of the corn aphis (*Aphis maidis*) in transmitting mosaic disease in cane is too well known to our readers to warrant discussion here. It is almost as well known amongst the planters themselves that corn is the preferred host of the moth stalk borer and that the earlier generations multiply very quickly on early corn, only to pass in enormous numbers to the sugar cane once the corn has begun to dry out.[2] It may not be so generally known by our planters, however, that the rough headed corn stalk beetle, which has been so injurious in cane stools this past spring, also breeds most commonly in corn, and this insect furnishes us with a strong argument against the planting of corn in legumes used for rotation. The rough headed corn stalk beetle *does not* breed in soy beans or cow peas ; hence when a canefield infested with these beetles is rotated with legumes without corn it is very probable that when the next crop of cane is planted there will be no larvae of these beetles in the field. When we

[1] *Loc. cit.*

[2] Hinds, W. E.—Sugar Cane Borer Control aided through Utilization of Infested and Trap Corn. *La. Agr. Expt. Sta. Bull.* 198 ; April, 1927.

plant corn in these rotated fields, however, besides helping along moth stalk borer infestation, we are simply perpetuating the presence of the extremely injurious corn beetle. Undoubtedly, the finding of a substitute crop for corn in Louisiana, in order to facilitate the handling of our stock food problem, is one of the principal projects facing our Experiment Station.

BURNING THE TRASH.

While probably not a factor of fundamental importance, there seems reason to believe that the discontinuance of the rather general custom in Louisiana of burning off the canefields and the turning under of this trash, would both benefit soil conditions and help to some extent in borer control. Many borer parasites, particularly the ubiquitous egg parasite (*Trichogramma pretiosa*) are destroyed by the burning of the trash, which friends might otherwise manage to survive the winter and show more appreciable effect in early generations of borer than they now do. While in Louisiana from about August 1st the percentage of borer eggs infested with this tiny wasp is comfortingly large, they never seem to get in their best work until the borers have reached almost maximum numbers. If we could obtain this high percentage of egg infestation even one generation earlier, the resulting mortality to borers would be very large. Many planters seem to think that the turning under of the trash is an impossible proposition and state that they burn only because it makes easier the subsequent handling of their fields. We agree heartily with the planters that turning under of the trash is impracticable if an attempt is at once made to put it deep under the soil. When the trash is heavily covered with soil the very process of decomposition in which we are most interested is largely prevented. If, however, the trash is simply lightly covered at the first attempt to get rid of it, decomposition will proceed fairly rapidly in the average moist Louisiana winter, and no great difficulty will be encountered the following spring in working the land.

THE DAY SYSTEM OF LABOUR.

Finally, there is another factor which, like the above, while probably not entitled to classification as fundamental in the present crisis, has at least considerably added to the costs of the Louisiana crop for many years. This is the practice of paying labour by the day, instead of by the task as is the almost universal practice in other sugar producing countries. For example, Mr. S. G. RUEGG, writing on labour and related problems in Hawaii,[1] has the following to say in regard to method of payment to labourers in that progressive country :—

"The labourers are encouraged to take contracts that will enable them to earn more money and produce a greater number of units of work. The plantation manager organizes the work of the plantation so that he can let out the hoeing of the fields, the irrigation of the cane, fertilizing, cutting, loading and hauling on the unit basis. The gang plan produces too many shirkers who live off the sweat of the others. They have thus a remarkable system of book-keeping which works out to the advantage both of the worker and the factory owner."

Anyone who has studied the day system as compared with the task system of labour must come to the inevitable conclusion that the former sets a premium on inefficiency and slothfulness. Too often, particularly

[1] RUEGG, S. G.—"Labour and Race Problems in Hawaii."—*The Planter and Sugar Manufacturer*, Vol. LXVII, No. 24, pp. 469-70 : 11th December, 1926.

during the last several lean years when a large amount of the better labour has left the plantations, the amount of work done per day is largely determined by the speed of the poorer and older labourers who have remained on the plantations. While it may seem complicated to those who have never worked with the task system generally, it is a comparatively simple matter to fix for each operation the amount of work that a man and a team should accomplish per day, and pay for that work accordingly, thus insuring a proper day's wages to the average worker and providing for the ambitious worker an opportunity to earn, by additional effort, commensurately increased payment.

Conclusion.

Here, then, are briefly a few of the factors which have brought the historic sugar industry of Louisiana to its present low ebb and a few suggestions as to how some of these conditions may be corrected. The writer is very optimistic, despite the ever increasing scourges which the industry has suffered of recent years, that the ebb of the tide has now been reached and that the Louisiana planters, better equipped than before through the experience of these same scourges, may look forward confidently within a relatively short period of time to the day when Louisiana will be producing not only crops of yester-year but considerably larger ones—when not two, but five or ten stalks of POJ cane will have been made to grow where but one of D 74 or Louisiana Purple grew before.

In connexion with the question of large beets, Mr. E. Saillard, Director of the Laboratory of the Syndicat des Fabricants de Sucre de France, has received two beets weighing 4·5 and 4·7 kg. (9 lbs. 14 oz. and 10 lbs. 5 ozs.) with sugar contents of 13 and 13·7 per cent respectively. Mr. Munerati, Director of the Experiment Station at Rovigo, Italy, states that he has harvested roots weighing 11 kg. (24¼ lbs.), but these contained only 6 to 7 per cent. of sugar. These abnormally large roots do not transmit this characteristic of size to their succeeding generations, so that their unusual size would seem to be due to special conditions of cultivation or climate.

In trials made with the Lafeuille rotary crystallizer in Natal,[1] last massecuites were cooled from 65-75° C. down to 30-40° C. in 2½ to 3 hours, whereas in the same time in ordinary crystallizers the temperature drop was only 6-8° C., other conditions being approximately the same. Moreover, the molasses from the Lafeuille apparatus was poorer, the average drop in purity for the first two weeks of trial having been about 4°, and the increase in the weight of crystals, about 6 per cent. of the weight of the massecuite. Later in the season, it was not uncommon to have decreased purity values of 6-8° and increased yields of 7-10 per cent. It is considered that the installation of this apparatus is justified by reason of :—economy of space; rapidity of cooling; increased recovery of 1st and 2nd sugars, and decreased amount of molasses for reboiling.

Mr. K. C. Bannerji, Secretary, Sugar Technologists Association of India, of P. O. Ghughli Dist., Gorakhpore, India, in a recent letter addressed to the press makes the following appeal to associations and other bodies interested in the development of the sugar industry. "The advantage of frequent exchange of ideas and comparison of figures and experimental results is obvious and will tend toward great and rapid improvements. Although every sugar country has its own problem to solve and the results of one experimental station cannot directly be applied by another, yet they are always suggestive and can be often modified and applied by another country. The objects of the International Society of Sugar-cane Technologists are very laudable, but their meetings are few and far between. What is required is a frequent exchange of ideas through exchange of facts and figures and other periodical reports of the Associations in the different parts of the world." Those in sympathy with this suggestion are invited to write to Mr. Bannerji with the view to formulate plans.

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[1] *S.A. Sugar Journal*, 1927, May 31st. 1927.

Recent Work in Sugar Cane Agriculture.

SUGAR CANE BREEDING TECHNIQUE: ISOLATION OF LIVE ARROWS FROM UNDESIRED POLLEN THROUGH ARTIFICIAL ROOTING OF CANES. **T. S. Venkatraman and R. Thomas.** *Agricultural Journal of India, Vol. XXI, May,* 1926.

As will have been noted in a recent description of the raising of seedling canes in Java,[1] the flooding of the air with pollen at certain times makes it difficult to determine male parentage with scientific accuracy. For practical purposes, this is not a matter of very great moment; by the methods adopted, the great bulk of seedlings raised will be crosses between two selected parents, and the rigid selection subsequently practised among the seedlings will eliminate any which are undesirable from a crop point of view. But for scientific purposes it is sometimes desirable to be quite certain on this point, and various more or less complicated methods have from time to time, been adopted to realize this certainty. The method described by the authors of this paper, while perfectly sound in principle, is on entirely fresh lines, and appears to be a simple and ingenious means of getting over the difficulty. It merely takes advantage of the well known fact that the root eyes with which every joint of the sugar cane is liberally provided lie dormant as long as they are kept dry and exposed to the light and air; whereas, as soon as they are placed in the dark and moistened, they emerge in large numbers. This occurs in the aerial cane shoots, for instance, when the leaf sheaths remain attached and are filled by the monsoon rains, or more generally, when the canes are cut up and placed in moist earth.

The process of inducing and intensifying these conditions on the aerial parts of plants is known in horticulture, broadly, as *layering*; a practice commonly used to multiply desirable forms of carnation in temperate climates, and mangoes in the tropics. It was argued that, if this could be done with a cane shoot, pre-determined as about to form an arrow, it would be possible to cut it off and transfer it to some place outside the plantation, where it would be no longer in danger of being dusted with undesired pollen. In this work the authors appear to have been entirely successful, and thus a distinct advance has been made in the technique of raising seedling canes. The details of this method are clearly described and illustrated by a number of photographs and drawings. Use is made of the local roofing tiles produced at a cheap rate for the native. These are, we believe, made for convenience in the form of bottomless flower pots, upright marks being made on opposite sides in the wet clay, through which on drying the pots can easily be split into two halves. Such halves are ideal for bringing a mass of moistened soil around any portion of the erect cane stalk. Those about to flower give well known indications beforehand, by the elongation of the upper joints and the diminution of the leaf blade; and root formation is so rapid that there is plenty of time to layer the shoot before the arrow is ready for emergence. At the time of layering, the cane is cut half across immediately below the portion to be tested, both to make subsequent detachment easier, and to stem any downward flow of sap from the still active upper leaves.

It has been found that the signs of flowering can be detected nearly one month before emergence, whereas a full development of new roots can be secured in half that time. The total severance of the shoot thus treated made no difference in the percentage of open anthers and the number of germinating seeds, as compared with untreated shoots left as controls. The advantage claimed for this method over the former, rather clumsy and often

[1] *I.S.J.*, 1927, pp. 20-21.

insecure one of caging the arrows inside close-meshed cotton fabric, lies not only in the greater security against foreign pollen, but also in a higher percentage of germination ; it has long been known that the higher temperature and lack of free air inside the cage had an injurious effect on the health of the enclosed arrow. In case of incomplete sterility of the male organs of the arrow, the possibility of self fertilization is of course not excluded.

THE DISTRIBUTION OF THE ROOTS OF THE SUGAR CANE IN THE SOIL OF THE HAWAIIAN ISLANDS. **H. Atherton Lee.** *Plant Physiology, Vol. I, No. 4.*

This paper initiates a study of the root system of the different varieties of sugar cane grown in Hawaii, under varying conditions of moisture and in different soils ; and is a natural corollary to the intensive investigation into irrigation problems which is being so enthusiastically followed in that country. and especially to the research on the duty of water. We judge that the present paper is of a preliminary nature, clearing the ground for other work , for the author on several occasions refers to a fuller treatment of side lines connected with the physiology of the roots of the sugar cane, which will form the subject of future papers. This is very encouraging, for any further light upon the range and character of the root system of the sugar cane is to be welcomed ; and, moreover, will be especially so in this territory, where such full information already exists as to the methods of irrigation, duty of water, and application of artificial manures, whether by irrigation or in other ways. As the author remarks, the greatest efficiency in the use of fertilizers lies in placing them where they can be most quickly available to the greatest number of roots ; and also the costly cultivation practices would render the greatest services if correlated with an accurate knowledge of the relative distribution of the feeding roots in the different layers of soil, so as to be able to avoid the loss caused to the growth of the plant by injuring them : one of the main results of this investigation is that the feeding roots are found to be surprisingly near to the surface.

The box method of root study.—In the first experiments, boxes 30 ins. in each dimension, with shelves of wire netting at short intervals, were filled with earth and cane sets planted in them. At the end of the experiment, the sides of the boxes were removed and the soil washed out, leaving the root system, more or less in place, entangled in the meshes of wire. An attempt was made to compare the amount of root development at different levels by linear measurement. This proved to be an extremely laborious if not an impossible task, and was given up in favour of cutting out all the roots in different layers of soil, drying them and comparing their weights. The first results recorded in the paper were obtained by this method. Each figure obtained was the average of three separate experiments, and the layers treated of were the uppermost 8 ins. of soil and successive deeper layers of about the same thickness. Of the results recorded in this first and other Tables, only the total weight of roots and the percentage of this weight in the different layers will be given here.

Experiment I. Comparisons of roots developed on loose, sandy loam and in compact loamy clay ; D 1135, five months' old cane.

Results : Sandy loam : 78 grms. roots ; 64, 19, 7, 9·5 per cent. (in layers proceeding downward).

Loamy clay : 156 grms. roots ; 65, 19, 7, 9·6 per cent.

But the box system was obviously only applicable to young plants ; and the author had doubts as to the validity of the results as to field conditions. The soil was better aerated than usual in the boxes, irrigation was more frequently

applied, and it appeared possible that the presence of the layers of wire netting might influence the results. The box system was therefore discarded.

Method designed for studying the roots in the field.—This consisted in pegging out an area including five stools of cane ; cutting these off at ground level, and taking this as the base line ; then digging out successive layers of soil and collecting all the roots therein ; and washing, oven-drying and weighing the separate lots as before. The method described in some detail appears to be satisfactory in the main, the bits of root being collected by throwing the excavated fine soil against an inclined wire netting of quarter-inch mesh ; the roots were caught by the netting and the soil passed through. The results are given below of the eight further experiments recorded in this paper, abbreviating as before by only giving the total weight of roots and the percentages in the different layers ; 8 in. layers are indicated unless the contrary is stated. Further, the fractions are left out and the nearest whole number given, excepting in those cases, as in the end figures, where the fraction is an important part in the total. Each figure is an average of five clumps of cane.

Experiment II. H 109 plant cane 10·5 months old.

Results : 193 grms. of roots ; 70, 23, 6, and 2·9 per cent.

A photograph is appended of the masses of roots obtained from the different layers, and it is remarked that the roots in the uppermost 8 ins. were lighter in colour, because of the larger proportion of young feeding ones. The author points out also that the percentages agree fairly well with those obtained by the discarded box method in Experiment I. In both, an unexpectedly high percentage of roots was collected from the upper 8 ins. of soil, and over 90 per cent. occurred within 2 ft. of the surface.

Experiment III. Yellow Tip, two fields compared, with 35 and 75 tons of cane per acre respectively ; both unirrigated and with identical manuring, and excavated when 26 months old.

Results : 35-ton field : 104 grms. roots ; 70, 19, 9, 2·9 per cent.
75-ton field : 148 grms. roots ; 73, 18, 7, 2·0 per cent.

Experiment IV. Seven months canes were compared with eleven months (the varieties were different, being Yellow Tip and Badila, but this was considered immaterial for the experiment).

Results : 7 months field : 35 grms. roots ; 75, 17, 8 per cent.
11 months field : 46 grms. roots ; 69, 19, 12 per cent.

Experiment V. Different soils : heavy adobe soil with irrigated H 109, 16 months old plant cane, and loose sandy loam with the same variety 11·5 months old. The canes were planted as in the previous experiments in furrows, and a small proportion of roots wandered into the adjoining higher soil of the sides (hill).

Results :—Heavy adobe : 58 grms. roots ; (hill) 0, 75, 19, 5, 0, 0 per cent.
Sandy loam : 148 grms. roots ; (hill) 4, 55, 23, 9, 5, 4 per cent.

These results, although not proving it, indicate that the rooting is deeper in the sandy loam than in compact clay soil ; and this suggests that greater aeration is an important factor.

Experiment VI. A closer study of different soils : semi-adobe with 22 months old plant cane, and loose alluvial silt with 21 months old 2nd ratoons, in both cases H 109.

Results :—Semi-adobe : 176 grms. roots ; (hill) 5·4, (0-2 in.) 18, (2-8 in.) 53, 11, 2·5, 1·1, 0·3 per cent.
Alluvial silt : 162 grms. roots ; (hill) 2·2, (0-2 in.) 18, (2-8 in.) 42, 23, 8·9, 4·4, 1·0 per cent.

Loose alluvial silt has a notably larger percentage of roots at lower levels, yet even here 62 per cent. are found in the first 8 in.; difference in soil is a more important factor than ratoon or plant cane. An interesting diagram is drawn of the root system of the 21 months old H 109; and the author notes that the roots at the lowest level are always near the centre of the excavated pit, thus immediately under the aerial part of the plant; while the whole root mass has somewhat the shape of a turnip. Thus far, in every excavation, cane tonnage bears a relation to the total weight of roots: in the present case there were 115 tons on the semi-adobe and 113 on the alluvial silt.

Experiment VII. Comparison of three months Lahaina and H 109, under comparable conditions of environment.

Results :—Lahaina : 15 grms. roots ; 88, 11, 0·8 per cent.
H 109 : 32 grms. roots ; 89, 10, 1·3 per cent.

The higher centre of gravity is noted of the root system in young canes as compared with old ones, as well as the fact that, although the H 109 in the experiment has double the weight of roots, the distribution in both canes is nearly the same. It is suggested that Lahaina was probably suffering from its well known susceptibility to various types of root failure (see the next experiment).

Experiment VIII. Comparison of 16 months old Lahaina with 15 months old H 109, under comparable conditions of environment. Both were ratoons, and grown on ridges instead of furrows.

Results :—Lahaina : 371 grms. roots ; 19, 43, 23, 11, 3·24 per cent.
H 109 : 374 grms. roots ; 13, 47, 25, 12, 2·9 per cent.

These results show no appreciable differences in the distribution. The great weight of roots was due to the stools being placed wider than usual; but on the basis of roots per volume of soil, the quantities were not regarded as abnormal. There are two distinct types of practice in Hawaii, the cane being grown on ridges or in furrows. In this experiment the canes had been hilled up, as contrasted with all the previous experiments recorded, where the plants were grown in furrows; and the results are markedly different. Wherever the canes are grown in furrows they have the largest proportion of roots in the top 8 in., in hilled canes the highest proportion lies between 8 and 16 in. from the surface. In both hilled up and furrow canes, however, the quantity of roots per volume of soil is greatest in the uppermost 8 in. (the surface in the one case is the top of the ridge and in the other the bottom of the furrow, materially altering the amount of soil in the top 8 in.). In both methods of cultivation, excavation studies have shown that over 85 per cent. of the cane roots are found in the first two feet, and most of the experiments have given a higher proportion.

A photograph is printed of the masses of the 16 months old Lahaina roots in the different layers, and a further interesting diagrammatic drawing is given of the distribution of the 15 months old H 109 roots.

Experiment IX. Comparison of D 1135 with H 109, in loose sandy soil under comparable conditions, both being grown in the furrow.

Results : D 1135 : 184 grms. roots ; (hilled up soil between the rows) 10, 49, 19, 12, 7, 3·43 per cent.
H 109 : 121 grms. roots ; (hilled up soil between the rows) 3·6, 60, 24, 4, 4·5, 3·5 per cent.

D 1135 is often grown without irrigation in Hawaii, and is generally regarded as more drought resistant than most kinds of cane. It is interesting therefore to note that most of its roots are in deeper layers than those of H 109, and also that the total weight of roots is much greater.

SOME APPLICATIONS.

In this section the author has obviously exercised great restraint, and he could doubtless have developed suggestions in every direction ; it is to be presumed that the future papers referred to will deal with such matters more fully, as data from fresh observations accumulate. The following are the chief points noted at present.

Soil samples for chemical and physical analyses should be taken where there are the greatest proportions of roots. Therefore it is safe to disregard ayers deeper than 4 ft., and for preference to concentrate on the top 8 in. layer and that between 16 and 24 in. So also in estimations of soil moisture.

From the diagrams of furrow and ridge planting, it is obvious that irrigation water will reach a much larger proportion of roots in furrow planting than in ridge planting, as in the latter the water runs between the cane rows. On the other hand there is better aeration with ridge planting, a matter of importance as to root and other rots. In unirrigated land the roots are better aerated in ridge planting and have a greater feeding surface.

The root masses in the upper layers are lighter coloured, in fact a light brown, while in the deeper layers they are dark brown to black. This is apparently owing to the greater number of fresh feeding roots in the upper layers and root and cortex rots in the lower. Hence the suggestion that aeration may be the chief factor both in developing secondary feeding roots and in preventing cortex and probably also stele rots.[1]

Data indicate the importance of avoiding cutting the roots in cultivation ; it has already been observed that heavy exudation takes place from cut cane roots and this has been constantly noticed during these experiments. But if aeration is the chief factor to be aimed at, deep tillage before planting and the incorporation of vegetable matter at lower levels acquire extreme importance.

There is practically no rotation in Hawaiian cane fields and little fallowing, and the question arises as to how long this may be continued, without decreasing the yields of cane. It has been stated that the deposition of dead roots in the soil will do much to counter this evil ; but the question must be left open, until data are accumulated as to what amount of vegetable matter is thus returned. From the results obtained in these experiments it is calculated that, with the usual 8500 clumps of cane to the acre, from 0·9 to 1·85 tons of dry organic matter are rendered available per crop (presumably per acre).

C. A. B.

The Queensland Cane Growers' Council, constituted under the "Primary Producers' Organization and Marketing Act of 1926," is stated to be the only body that has any authority to speak for and on behalf of the sugar producers of Queensland, and is recognized as such by the Queensland State Government.

A curious development of the White Australia policy on the Queensland cane-fields is attracting attention (writes a correspondent of the *Times*). Under present tariff conditions Australians are paying about £2 per ton more for local-grown sugar than for imported sugar. It was believed that the wages which this fiscal aid would permit would persuade Australians to enter the cane-brakes, but the labour contracts made for the season's cutting, which has just begun, show that there are only 19 British subjects among 742 cane-cutters, the rest being mainly Italians, with some Spaniards, Yugoslavs and Hindus.

[1] The writer is not quite convinced of the validity of the comparison, by weighing, of the young and tender feeding roots and the old blackened ones, even after drying ; the older ones will have thicker and probably heavier cell walls. But the point is perhaps immaterial.

Deterioration of Cane Mill Juices and its Prevention by Antiseptic Measures.

By Dr. JOHN H. HALDANE,
Central Control Laboratory, Messrs Begg Sutherland & Co., Ltd.

During the past few years, it has been recognized that during milling operations, there is a considerable loss of sucrose from deterioration due to bacterial action, the loss occurring in two distinct ways—as a direct result of the metabolism of the organism concerned and indirectly through the medium of the acid produced in some cases by such metabolism. Since the sucrose in cane is generally determined by the addition of sucrose in mixed juice and sucrose in bagasse—no direct method of accurately determining the sucrose in cane entering the factory having, as yet, been developed—loss of sucrose during milling operations is obscured. That an undetermined but distinct overhead loss does occur may be readily noted from a comparison of purity differences between first expressed juice and mixed juice in factories operating under the usual conditions and the lessened difference in these purities when steps are taken to keep the plants, etc., in as sanitary a condition as possible.

Preliminary experiments made during season 1924-25 led the author to believe that the use of a cheap and efficient antiseptic such as "E.C."[1] to suppress the inverting activity of micro-organisms, would fulfil a valuable purpose in the sugar factory. Since 1924-25, "E.C." as antiseptic has been systematically used in factories operated by Messrs. Begg Sutherland & Co., Ltd., and the results obtained have been entirely satisfactory.

That "E.C." is an efficient antiseptic is clearly indicated by the results obtained by the following experiments carried out in the Central Control Laboratory.

Samples of Crusher, 1st Mill, 2nd Mill, 3rd Mill, 4th Mill and 5th Mill juices were treated with "E.C." and the purity compared with untreated samples after one and two hours' standing. Table I shows that whereas the following decreases in purity occurred in untreated samples, Crusher 0·42; 1st Mill 0·47; 2nd Mill, 1·00; 3rd Mill, 1·70; 4th Mill, 1·94; and 5th Mill, 1·96, no decrease in purity could be detected in those samples treated with "E.C."

A similar experiment to that quoted above was carried out using samples of crusher juice, mixed juice and last mill juice. Table II shows that although no apparent decrease in purity had occurred in those samples treated with "E.C." the following decreases in purity were noted in the untreated samples: crusher juice 0·49, mixed juice 0·64, last mill juice 1·93.

"E.C." Antiseptic *v.* Formalin.

In order to compare the efficiency of the antiseptic properties of "E.C." with those of formalin equal volumes of crusher juice, mixed juice and last mill juice were treated with equal quantities of "E.C." and formalin respectively. The purities of the various samples determined at regular intervals are shown in Tables III, IV and V.

Crusher Juice.—After six hours' standing, the untreated juice sample showed a decrease in purity of 3·10 while samples treated with 2, 4, 6, 8 and 10 c.c. of "E.C." containing 2 per cent. available chlorine showed a decrease in purity of 0·51, 0·47, 0·24, 0·00 and 0·00 respectively—those samples treated with 2, 4, 6, 8 and 10 c.c. formalin showed a decrease in purity of 1·00, 0·66, 0·25. 0·22 and 0·00.

[1] *I.S.J.*, 1926, 85.

TABLE I.

Untreated Juice Samples, 1000 c.c.

Treated Juice Samples, 1000 c.c. + 5 c.c. E.C., containing 2 per cent. available Chlorine.

Time Interval.	Crusher Juice Purity.	Crusher Juice + E.C.	1st Mill Juice.	1st Mill Juice + E.C.	2nd Mill Juice.	2nd Mill Juice + E.C.	3rd Mill Juice	3rd Mill Juice + E.C.	4th Mill Juice.	4th Mill Juice + E.C.	5th Mill Juice.	5th Mill Juice + E.C.
INITIAL	85·02	85·02	84·94	84·94	79·44	79·44	78·94	78·94	76·29	76·29	73·83	73·83
1 hour	84·81	85·02	84·68	84·94	78·84	79·44	78·14	78·94	75·81	76·29	72·90	73·83
2 hours	84·60	85·02	84·47	84·94	78·44	79·44	77·24	78·94	74·35	76·29	71·87	73·83
PURITY DECREASE	0·42	Nil	0·47	Nil	1·00	Nil	1·70	Nil	1·94	Nil	1·96	Nil

TABLE II.

Time Interval.	Crusher Juice.	Crusher Juice + E.C.	Mixed Juice.	Mixed Juice + E.C.	Last Mill Juice.	Last Mill Juice + E.C.
INITIAL	82·45	82·45	80·18	80·18	69·47	69·47
1 hour	82·23	82·45	79·86	80·18	68·82	69·47
2 hours	81·96	82·45	79·54	80·18	67·54	69·47
PURITY DECREASE	0·49	Nil	0·64	Nil	1·93	Nil

TABLE III.

Crusher Juice 1000 c.c. 1000 c.c. Crusher Juice.

Time Interval.	Crusher Juice.	C.J. 2 c.c. + E.C.	C.J. + 2 c.c. Form.	C.J. + 4 c.c. E.C.	C.J. + 4 c.c. Form.	C.J. + 6 c.c. E.C.	C.J. + 6 c.c. Form.	C.J. + 8 c.c. E.C.	C.J. + 8 c.c. Form.	C.J. + 10 c.c. E.C.	C.J. + 10 c.c. Form.
INITIAL	84·42	84·42	84·42	84·42	84·42	84·42	84·42	84·42	84·42	84·42	84·42
3 hours	83·06	84·42	84·15	84·42	84·42	84·42	84·42	84·42	84·42	84·42	84·42
6 hours	81·32	83·91	83·42	83·95	83·76	84·18	84·17	84·42	84·22	84·42	84·42
TOTAL DECREASE IN PURITY	3·10	0·51	1·00	0·47	0·66	0·24	0·25	0·00	0·20	0·00	0·00

TABLE IV.

Mixed Juice 1000 c.c. — 1000 c.c. Mixed Juice.

Time Interval	M.J. + 1000 c.c.	1000 c.c. M.J. + 2 c.c. E.C.	1000 c.c. M.J. + 2 c.c. Form.	1000 c.c. M.J. + 4 c.c. Form.	1000 c.c. M.J. + 4 c.c. Form.	1000 c.c. M.J. + 6 c.c. E.C.	1000 c.c. M.J. + 6 c.c. Form.	1000 c.c. M.J. + 8 c.c. E.C.	1000 c.c. M.J. + 8 c.c. Form.	1000 c.c. M.J. + 10 c.c. E.C.	1000 c.c. M.J. + 10 c.c. Form.
INITIAL	82·02	82·02	82·02	82·02	82·02	82·02	82·02	82·02	82·02	82·02	82·02
3 hours	81·16	81·86	81·72	82·02	82·02	82·02	82·02	82·02	82·02	82·02	82·02
6 hours	78·53	80·94	80·62	81·45	81·24	81·82	81·68	81·88	81·83	82·02	82·02
Total decrease in purity	3·49	1·08	1·40	0·57	0·78	0·20	0·34	0·14	0·19	0·00	0·00

TABLE V.

Last Mill Juice 1000 c.c. — 1000 c.c. Last Mill Juice.

Time Interval.	L.M.J.	L.M.J. + 2 c.c. E.C.	L.M.J. + 2 c.c. Form.	L.M.J. + 4 c.c. E.C.	L.M.J. + 4 c.c. Form.	L.M.J. + 6 c.c. E.C.	L.M.J. + 6 c.c. Form.	L.M.J. + 8 c.c. E.C.	L.M.J. + 8 c.c. Form.	L.M.J. + 10 c.c. E.C.	L.M.J. + 10 c.c. Form.
INITIAL	69·87	69·87	69·87	69·87	69·87	69·87	69·87	69·87	69·87	69·87	69·87
3 hours	67·17	69·87	69·87	69·87	69·87	69·87	69·87	69·87	69·87	69·87	69·87
6 hours	61·57	69·87	69·87	69·87	69·87	69·87	69·87	69·87	69·87	69·87	69·87
Total decrease in purity	8·30	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil

TABLE VI.

Purity Decrease.	M.J.	M.J. + 2 c.c. E.C.	M.J. + 2 c.c. Form.	M.J. + 4 c.c. E.C.	M.J. + 4 c.c. Form.	M.J. + 6 c.c. E.C.	M.J. + 6 c.c. Form.	M.J. + 8 c.c. E.C.	M.J. + 8 c.c. Form.	M.J. + 10 c.c. E.C.	M.J. + 10 c.c. Form.
After 6 hours	12·78	5·12	4·64	4·22	3·45	2·65	2·41	2·28	2·03	1·86	1·88

Mixed Juice.—After six hours' standing, the untreated juice sample showed a decrease in purity of 3·49, whereas those samples treated with 2, 4, 6, 8 and 10 c.c. " E.C." showed a decrease in purity of 1·08, 0·57, 0·20, 0·14, 0·00 respectively—those samples treated with 2, 4, 6, 8 and 10 c.c. formalin showed a decrease in purity of 1·40, 0·78, 0·34, 0·19 and 0·00.

Last Mill Juice.—Whereas the untreated sample showed a decrease in purity of 8·30 after six hours' standing, no deterioration could be detected in those samples treated with " E.C." and formalin.

The results obtained from the previous experiments prove that the antiseptic properties of " E.C." are equal to those of formalin.

Further, from the results obtained by the following experiment, it may be stated that the prevention of deterioration of cane mill juices by the addition of " E.C." or formalin is partly dependent upon the initial acidity of the treated juices.

Mixed juice, derived from stale cane, having an initial purity of 71·96 was treated as in previous experiments with " E.C." and formalin respectively. From results shown in Table VI where a decrease of 12·78 in purity occurred in the untreated juice sample, a decrease of 5·12, 4·22, 2·65, 2·28 and 1·88 in purity was recorded in those samples treated with 2, 4, 6, 8 and 10 c.c. of "E.C." respectively.

Further it was noted that in all cases of untreated juice samples souring occurred after 3-6 hours' standing, while in those samples treated with " E.C." no souring could be detected even after 24 hours—in the last experiment where the initial purity of the mixed juice was 71·96, souring was noted in the untreated sample after one hour standing.

From an examination of the results shown in Tables I-VI, the conclusion may be drawn that although the inverting activity of micro-organisms can be suppressed by the addition of " E.C." or formalin, a loss of sucrose dependent upon acidity concentration and temperature will generally be recorded.

Application of " E.C." Antiseptic to Mills, etc.

As the very low cost of " E.C." allows of its use on the large scale required for a sugarfactory, the author would recommend the following procedure to be adopted as an aid towards prevention of deterioration of cane mill juices.

After a " wash down " and periodically during milling operations, the mill beds, mill cheeks, gutters, intermediate carriers, etc., should be sprayed with " E.C." containing 2 per cent. available chlorine. Further, a continuous trickle of the antiseptic—diluted to 1 part in 500 at the beginning of the season and increased to 1 in 200 towards the end of the season—into all juice gutters would be a preventive measure against deterioration of the juices during their passage along gutters, through strainers, etc.

The maintenence of a milling plant, etc., in as sterile a condition as possible is all important, since a decrease in purity of mixed juice of 1·00 through deterioration corresponds to a loss of approximately 1·00 per cent. sucrose and a further decrease of approximately 1·00 per cent. in the boiling house efficiency.

Experiments are being conducted at Plane Creek, Mackay, Queensland, on the cultivation of cassava, arrowroot, sweet potatoes, and other crops for the supply of raw material for the production of power alcohol. It is desired to determine: the cost of production; suitability for rotation with cane; and effect on the soil, on cane diseases and pests and on diminishing weeds.[1]

[1] *Australian Sugar J.*, 1927, 116-117.

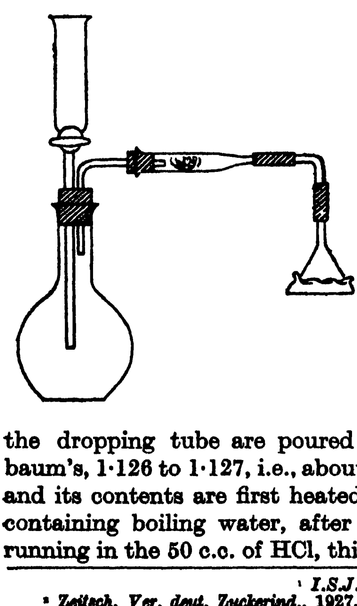
Determination of Sulphur Dioxide in Sugar Factory Products.

Following the papers reviewed last month on this subject,[1] three other contributions have appeared. The first is a paper which originates from the Institut für Zuckerindustrie in Berlin[2]; the second is a very important and particularly thorough report by Dr. G. W. MONIER-WILLIAMS, M.A., F.I.C., of the Ministry of Health, London,[3] issued with the view not to imposing any special method of analysis, but simply to provide a summary of information on the subject for analysts and others charged with duties in this direction; while the third is a short article by Mr. H. R. JENSEN, M.Sc., F.I.C.,[4] commenting on Dr. MONIER-WILLIAMS' report.

DRS. SPENGLER AND BRENDEL.

In the first contribution Drs. O. SPENGLER and C. BRENDEL state that German white (beet) sugars contain such a small amount of sulphur dioxide (SO_2) that a gravimetric method can hardly find application there. Titration with standard iodine provides a very useful preliminary test, 20 grms. of the sugar being dissolved in water to 100 c.c., and a N/200 (or near) standard solution of iodine run in, using a few drops of soluble starch as indicator. In most cases the end-point can be decided with a drop, but in others the coloration is more violet than blue, and the end-point is not sharp. A titration of the distilled water must at the same time be made, usually about 5 c.c. being found for this " blank,"

These authors then turn to the so-called " sulphide stain " method, as applied in the laboratories of Tate & Lyle, Ltd., and described by OGILVIE,[5] which procedure has been modified by them to some extent. The illustration (Fig.1) shows the apparatus used; the flask has a capacity of 400 c.c., and the funnel a diameter of 6 cm. (2⅜ in.); while the lead paper is made by soaking circular filter-paper (S. & S., No. 589, 9 cms. diam.) in a 25 per cent. solution of normal lead acetate, and allowing it to dry in the air, this being moistened before use. The filter-circles are laid on a round piece of flannel, 10 cms. diam. which at some distance from its edge is stitched through with strong thread; the funnel is placed on the paper, the two ends of the thread drawn together, the thread wound round the funnel over the flannel, and the ends tied together.



In the flask are placed 50 grms. of zinc (Kahlbaum's pure, for forensic purposes), 5 grms. of the sugar under examination, and 5 c.c. of water; while into the dropping tube are poured 50 c.c. of dilute hydrochloric acid (Kahlbaum's, 1·126 to 1·127, i.e., about 25 per cent.). It is advantageous if the flask and its contents are first heated by dipping for a minute into a small basin containing boiling water, after which the determination is commenced by running in the 50 c.c. of HCl, this taking 7-8 minutes. After another 8 mins.,

[1] *I.S.J.*, 1927, 305, 331.
[2] *Zeitsch. Ver. deut. Zuckerind.*, 1927, 167-178 (with two coloured plates showing eight sulphide stains).
[3] *Reports on Public Health and Medical Subjects, Ministry of Health, London*, No. 43, 1927; price 1s. 3d.
[4] *Food Manufacture*, 1927, 1, No. 2, 47-49.
[5] *I.S.J.*, 1926, 6'4.

the lead paper is removed, and the zinc left is washed with water. During this 15 minutes about 7 grms. of zinc will have been dissolved, which quantity is replaced for the determination following. Regarding the preparation of the standard sulphide stains, a solution of 0·15 grm. of sodium sulphite (anhydrous) in 1 litre is prepared, but, as part of this will be oxidized, according to the amount of dissolved air in the water, and depending on the time it is shaken during solution, it must be titrated against the N/200 solution of iodine, which itself is rather unstable at this high dilution, and should be checked against standard sodium thiosulphate. Sulphide stains are produced on the filter-paper circles to correspond to 70, 35, 20, 14, 8, 4, 2 and 1 parts per million of SO_2 in the sugar. Blank tests must, of course, be carried out from time to time using 5 grms. of pure sugar, in order to make certain that the zinc and hydrochloric acid are always quite sulphide free.

The effect of ultramarine (which still appears to be used for the blueing of sugar in Germany) was investigated. Its presence does not affect the iodine titration, but, as one would expect, it interferes with the sulphide stain method. A sugar which had purposely been very strongly blued with ultramarine showed an increase only of 16 p.p.m. of SO_2. Altogether these authors examined 38 samples of sugars (refined, crystal, melis, and other grades) by the two methods, but all were found to be well below the limit of 70 p.p.m., the results between the two checking well in all cases. A short review of literature on the subject is given.[1]

DR. MONIER WILLIAMS.

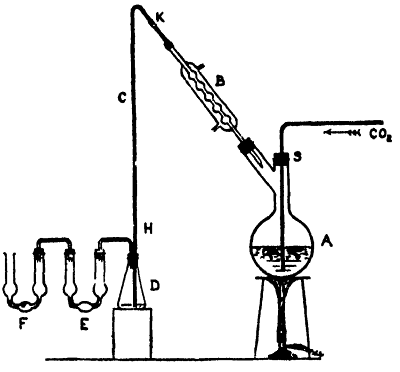
This contribution is in the form of an 8vo. 6-page report. It is a very excellent review of the most important literature published on the question to date, and it should be carefully perused by all interested. Replies to most of the criticisms made by Dr. DRAKE-LAW recently[2] will be found in it. It is explained, for example, that the sulphur dioxide present in a product may progressively diminish in amount, due to oxidation and volatilization, a loss which in many cases may explain the discrepancies in the results obtained on the same sample by different analysts. Further, that sulphur dioxide enters into combination with certain constituents in foods, some of which combinations as glucose sodium bisulphite, are not readily dissociated, even in acid solution. Unless the necessary precautions are taken, the presence of comparatively stable "hydroxy-sulphonic acids" of aldehydes, sugars, dextrins, etc., may affect to a considerable extent the determination of the total SO_2. It is possible that in cane factory juices any sulphurous acid present may combine to some extent with the dextrose and levulose. On the other hand, sucrose shows no tendency to combine with the SO_2.

It is concluded that distillation is the only reliable method for the majority of foods, provided the necessary precautions against error have been taken, viz., the separation of the whole of the sulphur dioxide from its combinations with aldehydes and sugars; the prevention of oxidation during distillation; and the correction of the results for volatile sulphur compounds oxidised to sulphuric acid in the distillation. Dr. MONIER-WILLIAMS has endeavoured to find some method of general application, which, while eliminating as far as possible the sources of error referred to, will permit of an accurate determination of the SO_2 in the distillation by titration. His method consists essentially of distillation in a current of carbon dioxide through a reflux

[1] The principal references being:—*Zeitsch. Ver. deut. Zuckerind.*, 1903, II, 417; 1914, I, 242; 1917, I, 194; *Cent. Zuckerind.*, 1916-17, 94. [2] *I.S.J.*, 1927, 305.

condenser into pure hydrogen peroxide, and titration of the sulphuric acid formed. Advantages of this procedure are that errors due to hydrogen sulphide and volatile organic sulphur compounds are eliminated, volatile acids do not pass over into the distillate to interfere with the titration, and it is not necessary to carry out a gravimetric determination, except when very small quantities of sulphur dioxide are in question.

A round-bottomed flask of 1500 c.c. capacity (A in Fig. 2), preferably provided with two necks, is connected as shown in the figure with a sloping reflux condenser (*B*). The lower end of the condenser should be cut off at an angle to facilitate a steady return flow of the condensate. The upper end of the condenser is connected by a vertical tube (*C*), about 4 to 4·5 mm. internal diam., to a 200 c.c. conical flask (*D*) followed by two Peligot tubes (*E* and *F*). The delivery tube reaches to the bottom of the receiver. The conical flask (*D*) contains 10 c.c. of pure ten-volume (3 per cent.) hydrogen peroxide, free from sulphuric acid. The first Peligot tube (*E*) also contains 10 c.c. of hydrogen peroxide, and the second (*F*) contains 5 c.c. of a mixture of hydrogen peroxide and barium chloride acidified with hydrochloric acid.[1] The object of this guard tube is merely to serve as a check on the complete absorption of sulphur dioxide in the first two vessels, since the slightest trace of escaping gas will give a turbidity of barium sulphate. In no case was this observed in these experiments. After the apparatus has been connected up, 500 c.c. of distilled water are introduced into the flask together with 20 c.c. of pure concentrated hydrochloric acid. This solution is boiled for a short time in a current of pure CO_2 to remove air. If the food is liquid, it can now be introduced through a tap funnel (not shown in the figure), 100 grms. being a convenient quantity in most cases. If the food is solid, the flask contents are first cooled by gradual immersion in a saucepan of water, the current of carbon dioxide being continued during cooling, and the food introduced by momentarily removing the stopper (*S*). The mixture is then boiled for one hour in a slow current of carbon dioxide. Just before the end of the distillation the flow of water in the condenser is stopped. This causes the condenser and delivery tube gradually to become hot, and any sulphur dioxide retained by condensed moisture in the tube is driven over into the receiver. The receiver (*D*) may be kept cold during this operation by means of a small vessel of water. Directly the vertical tube just above its point of entry into the receiver at (*H*) is hot to the touch, it is disconnected at (*K*). The tube is washed down into the receiver with a small quantity of water, and the contents of the Peligot tube (*E*) transferred to (*D*). The liquid, which will measure with washings about 40 to 50 c.c., is titrated at room temperature with N/10 sodium hydroxide solution, using bromphenol blue or methyl orange as indicator, preferably the former. If desired the titration figure may be checked by a gravimetric determination, the precipitation of the barium sulphate being carried out at room temperature.



[1] This mixture may be composed of the following: 20 grms. of barium chloride, 4 c.c. of concentrated hydrochloric acid, 400 c.c. of 10-vol. (3 per cent.) hydrogen peroxide in 1 litre, filtered before use.

This method was first tested on pure solutions of sulphurous acid, the amount added being determined by iodine titration; and by N/10 NaOH titration after oxidation with hydrogen peroxide, and the amount found being ascertained by titration with N/10 NaOH, and gravimetrically as $BaSO_4$. All the results obtained checked very closely. Aldehydes and volatile acids were proved to have no effect on the determination, and on applying it to a number of foods, results were obtained which showed a satisfactory correspondence before and after treatment with sodium bicarbonate solution (to decompose combined sulphurous acid), whether the amount of sulphuric acid found was determined volumetrically or gravimetrically. A corn syrup four months old, for example, give the following results by the four different methods: 397, 389, 392, and 391; and a plantation white sugar, 42, 37, 42, and 37, independent analysts finding in the latter example 35 to 36 p.p.m.

Mr. Jensen's Remarks.

Referring to the new Public Health Regulations as finally amended to April, 1927, this writer states: "The regulations as a whole now in being can certainly be described as thorough and effective. They are supremely just and fair to the various apparently conflicting factors of public health, cost, and technical practicability. The worst that may now be said is that there are apparent inconsistencies and several unnecessary sanctions, but these flexibilities arise from meeting actual facts rather than from rigidly adhering to some pre-supposed safe dose of preservative. All the proved demands of the various trades have now been reasonably met in the latest supplement."

Turning to the question of the correct estimation of SO_2, he states that a committee of eight chemists associated with the Food Manufacturers' Federation has been appointed to consider this matter. Pending the publication of their Report, it may be accepted as proved that the main reason for the frequent low results is that of oxidation in the distillation flask—very rapid when hot—to non-volatile sulphuric acid. It would appear that ordinary methods of de-aeration—vacuum or recent boiling—will not in themselves prevent all loss. With a metabisulphite control added last to still boiling ultra-de-aerated acid water, 97 to 99 per cent. of the theoretical sulphite can be estimated. With many food products such procedure is impossible. The undoubted ineffectiveness of carbon dioxide during distillation practically proves the critical importance of traces of dissolved oxygen, and perhaps of other reactive substances in gelatine, etc., in rapidly accelerating oxidation in solution, even when cold. Consequently, the practical method of reducing this loss to unimportance is to boil and distil with great speed, using resistant glass flasks.

In order to avoid other sources of loss, the following must be observed: (1) The use of efficient condensation for the products of distillation, and of absorption in the usual oxidizers by proper dispersing traps. (2) The use of a sufficiently high acidity in distillation—in many cases with hydrochloric acid, with a previous caustic soda treatment where necessary—to decompose or disintegrate anything retaining sulphur dioxide. (3) The avoidance of barium loss by correct conditions of precipitation, acidification, etc.; and (4) the filtration of the distillate. Volumetric iodine values are, of course, usually too high because of oxidation of other volatile compounds, such as terpenes, and because of volatilization of iodine. By attention to these fundamentals, and with a little practice, an accuracy within two or three parts per million on every 100 parts of sulphur dioxide present is definitely attainable.

Fortunately, in very many instances where sulphites are concerned, a sorting test is all that is necessary. By direct titration with iodine a maximum apparent value can often be obtained, by which materials may be classed either as within the legal limit or satisfactory for the purpose in view. In this way distillation can usually be avoided for sugars, glucose, boiled sweets, fondant, canned and dry fruits, jams, and starch. It must be noted, however, that as a rule the " combined " sulphite (aldehydic, ketonic, ester) must first be decomposed by a preliminary digestion with cold sodium hydroxide, followed by acidification and immediate direct titration. Ordinary glucose syrup, for example, may indicate less than half the real sulphite content without alkalization—although fully broken down by acid distillation—which suggests the extreme probability that these stable sulphite compounds, with sugar, starch, and perhaps cellulose, unoxidized even by iodine and heat resistant, are quite physiologically inert. In this connexion it is known that they no longer inhibit moulds. Our new regulations pay no regard whatever to the probable harmlessness of carbohydrate sulphites, for which many American States have made provision. Moreover, many people appear capable of tolerating large quantities of free sulphur dioxide without known injury, due to its normally rapid oxidation to harmless sulphate. Little provision appears to have been made for an original sulphur dioxide excess in certain foods and its inference.

Colloid Elimination during Bonechar Filtration in Cane Sugar Refineries.[1]

By H S. PAINE and M. S. BADOLLET,
Carbohydrate Laboratory. United States Bureau of Chemistry.

Regardless of the extent to which colloidal and colour properties are associated in the same compounds, it is certain that these two properties play quite distinct rôles in the refining process. In spite of the degree of correlation which may exist between them, it does not seem feasible to attempt to measure one in terms of the other. The colloidal properties of non-sugar compounds are no doubt fully as objectionable as their colour properties in the operation of refining raw cane sugar. It is therefore desirable to measure these properties independently. Some of the data obtained in a colloid survey of a cane sugar refinery are presented in this article. It was necessary to test the liquors after definite intervals throughout the period of filtration, sweetening off and washing. One bonechar filter was set aside for this experiment and a careful record kept of all operations necessary to complete a bonechar filtration cycle.

Measurements used in Investigation.

The hydrogen-ion concentration was measured electrometrically by means of the quinhydrone electrode.[2] Ultrafiltration was accomplished by means of standardized collodion membranes. The ultrafiltration residue was separated into two portions, one termed " reversible " and the other " irreversible." The former does not flocculate during ultrafiltration, has a relatively low ash content, and redisperses readily when it is dried and added

[1] Paper (here abridged) presented before the Sugar Division at the 72nd meeting of the American Chemical Society, Philadelphia, Pa., Sept., 1926.

[2] See Dawson, *Sugar* (1926), 28, 211, 262, 310, 369.

to water. The water-reversible portion is more highly hydrated than the irreversible fraction and corresponds more closely to the emulsoid type of colloids. The dye test is based upon the principle of neutralization of the electric charge of colloid particles by means of a dye of opposite charge.[1] A cataphoresis apparatus was used; this was devised by MATTSON[2] and consisted essentially of a capillary tube with an electrode chamber attached at each end. Because of the electro-osmotic movement of an aqueous solution in a capillary tube it is desirable, in order to measure the true speed of the colloid particles, to focus the microscope at a point in the capillary at which the electro-osmotic movement of the liquid is *nil*. This point, as found by MATTSON, is obtained by focussing at a distance of $0{\cdot}293 \times r$ (r = radius of capillary) below the upper wall of the capillary. When the electrically neutral point is reached the weight of dye used, divided by the weight of solids in the sample tested and multiplied by 100,000, is termed the dye value. The dye value increases with the colloid content. The assembly of an ultra-microscope and cataphoresis apparatus has been described in detail by the authors.[3] After a little practice a determination can be made in a few minutes. This is the most feasible method now available for making a rapid approximate quantitative determination of colloidal matter.

COLLOIDS PRESENT IN A FILTRATION CYCLE.

The complete bonechar filtration cycle during the period of our investigation required 72 hours and 40 mins., the time allowed for washing being 17 hours, which is long compared with the 4 to 7 hours allotted in some refineries. Some colloidal material and other non-sugar solids are removed from the bonechar by prolonged washing with hot water, and this is an advantage in preparing it for revivification. In practice the period of washing also depends somewhat on the immediate need for the filters and the bonechar.

The colloid data obtained at significant intervals in a bonechar filtration cycle are shown in Table I. In previous colloid investigations made by the authors it has been found that water-reversible colloids are always present in sugar liquors and are considerably more difficult to eliminate than those of irreversible type. Water-irreversible colloids are present in most sugar liquors, the percentage in raw cane sugar varying considerably with the manner of defecating and clarifying the cane juice. In these tests the clear Sweetland press liquor (filtered raw sugar melt) contained a considerable quantity of irreversible and reversible colloids, but upon passing through the bonechar filter the irreversible portion was completely removed, whereas the percentage of irreversible colloid was greater than that of the reversible fraction in the liquor entering the filter. Small quantities of reversible colloids passed through in the first portion of the char liquor and increased as the filtration continued. There is some evidence that as the liquors coming from the bonechar filter decreased in density with application of water pressure, the reversible colloids began to wash out of the bonechar, this being apparently due to a change in adsorption equilibrium as the solids concentration of the liquor in contact with the bonechar decreased. The evidence regarding release of a material proportion of reversible colloids from adsorption by bonechar during washing of the filter is not regarded as conclusive at this time. The subject is being further investigated by the authors.

[1] BADOLLET and PAINE, *I.S.J.*, 1926, 28, 97-137.
[2] *Kolloidchem. Beihefte*, 1922, 14, 278; *cf.* also BADOLLET and PAINE, *loc. cit.*
[3] BADOLLET and PAINE, *loc. cit.*

TABLE I.

Colloid Removal at Successive Stages in a Bonechar Filtration Cycle.

Sequence of stages in Bonechar Filtration Cycle.	Time Hrs. Min.	*pH.*	Approximate Quantitative Estimation of Colloids. Reversible by Ultrafiltration. (Per cent., based on total Solids of Liquor.)	Irreversible by Ultrafiltration.
Filling filter with bonechar and filtered raw sugar melt	2·10	..	..	..
Settling bonechar (sample represents filtered raw sugar melt entering bonechar filter)................	3·50	7·18	0·045	0·057
Char liquor (at end of 1 hr. run)	(1.0)	6·81	0·009	0·000
Char liquor (at end of 11 hrs. run) ..	(11·0)	7·02	0·021	0·000
Char liquor (at end of 31 hrs. run) ..	(31·0)	7·16	—	—
Duration of flow of char liquor......	33·40	—	—	—
Period from application of water pressure to flow of sweet water testing 12° Bé. (hot); sample taken about middle of period ..	5·0	7·12	0·036	0·000
Period from flow of sweet water testing 12° Bé. (hot) to flow of filtrate with polarization less than 0·4°; sample taken about 2 hrs. after beginning of period	7·0	6·70	0·019	0·000
Washing bonechar filter	17·0	—	—	—
Application of air pressure	2·0	—	—	—
"Pulling" bonechar	2·0	—	—	—
Total time	72·40			

DISCUSSION OF DATA.

From the data presented in Table I it is seen that the irreversible colloids were completely removed by the bonechar and were never present in the filtrate therefrom. When the bonechar was washed they remained completely adsorbed. Experiments which have been made on simultaneous adsorption of different types of colloids by carbon indicate that the quantity of irreversible colloids present may exert considerable influence[1] on the adsorption of colloids of water-reversible type and *vice versa.* The data of Table I indicate that bonechar has a distinctly preferential adsorbing action on irreversible sugar-liquor colloids as compared with those which are reversible in water. It would appear, therefore, that the preferential adsorptive action of bonechar on irreversible colloids would considerably diminish its adsorptive capacity for reversible colloids, with the result that the latter would partially pass through the bonechar filter and would tend to be washed out of the bonechar by a change in adsorption equilibrium when the flow of sugar liquor is stopped and water pressure is applied.

SURFACE TENSION AND COLLOIDS.

In previous work[2] dealing with the two general types of colloids present in sugar liquors, the reversible type has been most extensively studied. Since the irreversible type of colloids is difficultly dispersible in water, the best way to study its properties is by an indirect method. Diluted blackstrap molasses was ultrafiltered and the colloidal material recovered was

[1] *Cf.* FREUNDLICH, *Kapillarchemie*, Second Edition (1922), p. 269 *et seq.* for a discussion of the adsorption of capillary-active substances in mixture.

[2] *Cf.* PAINE, BADOLLET and KEANE, *loc. cit.*

separated into reversible and irreversible fractions. Surface tension measurements[1] were made on the molasses before and after ultrafiltration and on the ultrafiltrate after addition of the reversible colloids which had been removed. The differences in surface tension are an approximate measure of the relative surface tension effects of the two types of colloids in the molasses. These data are shown in Table II.

TABLE II.

Surface Tension Effects of Reversible and Irreversible Colloids in Molasses.

	Surface Tension, Dynes, per cm.
Diluted molasses	42·1
Ultrafiltrate from diluted molasses	51·2
Ultrafiltrate plus reversible colloids	45·2
Difference in surface tension due to irreversible colloids	3·1
Difference in surface tension due to reversible colloids	6·0

It is the general rule that colloids which most greatly depress the surface tension of water against air also most greatly depress the interfacial tension of water against an adsorbing solid. In many cases such colloids are also most tenaciously adsorbed by the solid substance—in this case bonechar. Unfortunately, in this experiment, the percentages of reversible and irreversible colloids in the molasses were not determined and no independent test relative to the presence of colloids in the ultrafiltrate was made. Consequently no conclusion can be drawn regarding the relative specific effects of reversible and irreversible colloids on surface tension and the data in Table II are presented merely as a matter of interest in indicating the approximate net effects of these two types of colloids in molasses upon the surface tension.

COMPARATIVE COLLOID CONTENTS.

The dye test, which gives a good approximation of the quantity of colloidal material present, showed about the same relations as to colloid removal as did ultrafiltration. Numerous tests were made on bonechar filtrates and were continued from the beginning of filtration to the end. Sweet waters ranging from about 15° Baumé to a polarization of 0·3° were found to contain considerable quantities of colloids. The colloidal material present in the filtrate at densities corresponding to about 25° to 15° Baumé was returned with the liquors to the vacuum pans and boiled into white sugar massecuites. The syrup from the first massecuite was boiled into a second massecuite and this procedure was followed until four massecuites had been made by consecutive boiling. The syrup from the fourth massecuite was char-filtered and boiled into a fifth massecuite.

The dye test was used for the purpose of making approximate comparative determinations of the colloid contents of liquors and sugars at various stages in the refining process. These data are presented in Table III. The successive massecuites showed a progressive increase in concentration of colloids. The granulated sugar (which represented a mixture of the five massecuites) showed, however, a practically constant colloid content, this being due to elimination of colloids during centrifuging and washing. The lot of raw sugar represented by sample No. 419 was of poor refining quality. It was passing through the refinery for a period of several days, so that an unusual opportunity was afforded for observation of its behaviour. An interesting comparison may be made between the dye values of liquors obtained from this lot of raw sugar and the dye values of liquors derived

[1] By means of the du Nouy tensiometer, using the revised technique recently announced by DU NOUY (pamphlets of the Central Scientific Company, Chicago) and KLOPSTEG (*Science*, Oct. 3rd, 1924).

from better grades of raw sugar. In every test the liquors from this sugar gave a larger dye value than those from any of the other sugars and yet the dye value of the granulated sugar was normal. The dye values for the affination syrups show that the wash-house of the refinery receives the greatest quantity of colloidal material. Judging by the dye values. the colloidal material in raw sugars is decreased to the extent of 59 to 78 per cent. by washing.

TABLE III.

Comparative Colloid Contents at Various Stages as indicated by Dye Test.

Raw sugar sample No.	721	429	511	419	640
Refining quality of raw sugar	Good	Very good	Medium	Poor	Good
	Dye Values				
Raw sugar	303	263	380	483	363
Affined raw sugar melt	96	67	96	177	87
Sweetland press liquor	87	58	87	96	87
Char liquor	12	9·6	9·6	39	14
Massecuite No. 1	12	7·2	12	58	12
,, No. 2	19	14·4	14	67	19
,, No. 3	38	24	39	67	29
,, No. 4	58	48	53	77	39
,, No. 5	82	—	48	—	—
Syrup before bonechar treatment	125	96	77	193	58
,, after ,, ,,	77	67	48	125	48
Granulated sugar	9	8	9	8	—
Affination syrup	1640	1394	1730	—	1346
Washed raw sugar	123	62	—	—	82
Sweet water passing to melter	96	67	—	—	77

The colloids which were present in the sweet water (15° to 2° Baumé, measured hot) passed to the raw sugar melter, while the sweet waters (varying from 2° Baumé to a polarization of 0·3°) were concentrated in the multiple effects and sent as evaporator syrup to the low-grade house of the refinery. In the latter the evaporator syrup, affination syrup, etc., were boiled into remelt sugars. Two of these remelt sugars were returned to the raw sugar bin and were carried to the centrifugals, some of it finally reaching the bonechar again. It is seen that extensive re-circulation of colloids in the refinery and return to the bonechar filters may result from the presence of colloids in sweet-water in substantial amount. From viscosity experiments with reversible colloids, it was found that this type of colloids increases viscosity considerably. This tends to decrease the rate of sucrose crystallization. There is reason to believe that, by adsorption on the faces of growing crystals, colloids may also decrease the rate of sucrose crystallization in a manner distinct from the influence of increased viscosity. The inclusion of colloids in sucrose crystals, presumably to a great extent as the result of adsorption, has been investigated by PAINE and BALCH.[1]

The Bureau of Business Research of New York University has just announced the establishment of a Sugar Statistics Division, under the supervision of Dr. JOSHUA BERNHARDT, who was sugar statistician for the U.S. Food Administration and Sugar Equalization Board during the War, and subsequently Chief of the Sugar Division of the U.S. Tariff Commission. He has more recently been connected with Farr & Co., the General Sugar Estates, and the Cuban Dominican Sugar Corporation. An inquiry made by the Bureau among 2,000 leading sugar concerns shows that a majority believe that an unbiassed and convenient summary and interpretation of sugar statistics would be of great value in supplementing present data.

[1] *I.S.J.*, 1926, 472.

The Sugar and Glucose Trades of the United Kingdom.

Third Census of Production Report, 1924.

The Third Census of Production in the United Kingdom, undertaken by the Board of Trade at ten-yearly intervals, was carried out in 1924. Owing to the war period, comparison had to be made with the year 1907, the last previous year when an investigation was made. The preliminary report relating to the sugar and glucose trades, as published in the *Board of Trade Journal*, gives the adjoined particulars.

The following statement shows the quantity and value of products manufactured in Great Britain by firms furnishing Returns in the years 1907 and 1924 on Schedules for the Sugar and Glucose Trades :—

Products.	1924. Quantity. Cwts.	1924. Value. £	1907. Quantity. Cwts.	1907. Value. £
Sugar, refined or rendered by any process equal thereto :				
Over 98° polarization	17,671,000..	40,219,000..	8,794,000	7,256,000
Not exceeding 98° pol'n...	2,114,000..	4,235,000..	2,506,000..	1,739,000
Total—Sugar	19,785,000..	44,454,000..	11,300,000..	8.995,000
Glucose :—				
Solid	462,000..	713,000..	761,000..	446,000
Liquid	1,251,000..	1,680,000..	468,000..	241,000
Total—Glucose......	1,713,000..	2,393,000..	1,229,000..	687,000
Molasses and invert sugar and all other sugar and extracts from sugar which cannot be completely tested by the polariscope :—				
Containing 70 per cent. and more of sweetening matter	2,174,000..	3,943,000..	2,199,000..	1,624,000
Containing under 70 per cent. of sweetening matter and more than 50 per cent.	1,202,000..	983,000..	..	
Containing not more than 50 per cent. of sweetening matter	126,000..	62,000..	1,111,000..	303,000
Total—Molasses, Invert sugar, etc.	3,502,000..	4,988,00	3,310,000 ..	1,927,000
Caramel :—				
Solid	2,000..	8,000..	45,000..	40,000
Liquid	127,000..	273,000..		
Total—Caramel	129,000..	281,000..	45,000*	40,000
Sugar, ground	165,000..	381,000..	275,000*	273,000
All other products	— ..	677,000..	— ..	393,000
Total value	— ..	53,174,000..	— ..	12,315,000

In any comparison of the total value of the products of the industry in the years 1907 and 1924 it is necessary to take into account the substantial

* In addition, 88,000 cwts. of caramel, valued at £84,000, and 12,000 cwts. of ground sugar, valued at £12,000, were returned on Schedules other than that for the sugar trade. When the Returns in kindred trades have been summarized, some additions will probably also require to be made in respect of the output of these products in the year 1924.

increase which has taken place in the rate of excise duty since the earlier year. In the year 1907 the duty charged on refined sugar exceeding 98° polarization was at the rate of 4s. 2d. per cwt.; the corresponding duty in the year 1924 was at the rate of 25s. 8d. up to the 30th April, when the reduction to the present rate of 11s. 8d. took effect.

The total quantity of sugar refined in bond which was entered for home consumption in 1924 was 17,368,000 cwts., and the exports in that year amounted to 1,447,000 cwts. In addition, 63,000 cwts. of British refined sugar were delivered from bonded warehouses in 1924, free of duty, for the use of the Navy and Army or for stores of merchant vessels. The aggregate quantity delivered from warehouses in the year was, therefore, 18,878,000 cwts. The total quantity of refined sugar produced in the year was returned to the Census Office as 19,785,000 cwts., an excess of 907,000 cwts. over the quantity delivered from warehouses, while the warehouse stocks in Great Britain were less at the end of 1924 than at the end of 1923 by 366,000 cwts. While absolute agreement between the two records would not be expected, the extent of the disagreement would be considerably diminished if the two returns were to relate to the same period of twelve months. The Returns furnished to the Census Office by some of the more important undertakings in the industry cover a period earlier than the year ended 31st December, 1924. In the twelve months ended 31st March, 1924, the Report of the Customs Department shows that 18,784,000 cwts. of sugar refined in bond were entered for home consumption, an excess of 1,416,000 cwts. over the corresponding figure for the calendar year 1924.

In the following statement the production during the year 1924 is compared with the exports and net imports in that year :—

Kind of Goods.	Production. cwts.	Exports. cwts.	Imports entered for Home Consumption. cwts.
Sugar refined :—			
Exceeding 98° polarization	17,671,000	*	11,247,000
Not exceeding 98° polarization	2,114,000	*	90,000
Total—sugar	19,785,000	1,447,000	11,337,000
Molasses, Invert Sugar, etc.—			
Containing 70 per cent. and more of sweetening matter	2,174,000	*	6,000
Containing under 70 per cent. and more than 50 per cent. of sweetening matter	1,202,000	*	100,000
Containing not more than 50 per cent. of sweetening matter	126,000	*	37,000
Imported free of duty for use in distilleries and for stock food	—	—	3,115,000
Total—Molasses, invert sugar, etc.	3,502,000	591,000	3,258,000
Glucose :—			
Solid	462,000	1,000	25,000
Liquid	1,251,000	37,000	910,000
Total—Glucose	1,713,000	38,000	935,000
Caramel	129,000	17,000	—

* Not separately distinguished.

Of the refined sugar exported in 1924, a total of 1,008,000 cwts. was consigned to the Irish Free State. There were also consigned to the same destination 21,000 cwts. of molasses, 34,000 cwts. of glucose and 5000 cwts. of caramel. In any comparisons with the position in 1907 these shipments must be taken into account.

In addition to the refined sugar imported, 2,558,000 cwts. of unrefined sugar, nearly half of which exceeded 97° polarization, was entered for home consumption in 1924, either for use by manufacturers or for direct consumption.

Net output.—The net output of the factories covered by the foregoing statement was £19,923,000, this sum representing the amount by which the selling value of the products exceeded the cost of the materials used. The net output per head of persons employed was £1578 in 1924 and £506 in 1907, both amounts being inclusive of duty. The output of refined sugar in 1924 was greater than in 1907 by 75 per cent., and that of glucose by nearly 40 per cent. On the other hand, as shown below, the number of persons employed increased by 94 per cent. and the horse-power of engines installed by 160 per cent., apart from any increase in the electrical power purchased. Even if this be neglected and it be assumed that all the power available in 1907 was fully utilized and only 72 per cent. in 1924, the increase in effective horse-power was about 87 per cent.

Persons employed.—The average number of persons employed in the industry during the year 1924 was 12,626, of which 11,356 consisted of operative staff and 1270 of management, technical and clerical staff. In the year 1907 a total average number of 6501 was returned, 5836 being wage earners and 665 salaried staff. Distributed according to age and sex, the numbers in the two years are as follows :—

	1924.			1907		
Ages.	Males.	Females.	Total.	Males.	Females.	Total.
Under 18 years	395	322	717	485	35	520
Over 18 years	10,684	1,225	11,909	5,798	183	5,981
Total	11,079	1,547	12,626	6,283	218	6,501

Amino Acids and Related Compounds in Sugar Products.

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I.—A SIMPLE COLORIMETRIC TEST FOR AMINO ACIDS.

It is well known that amino acids are present in the juices from sugar cane and beets and in raw sugar. During the processes of manufacturing white sugar, they are eliminated (1) by precipitation or adsorption before the crystallization of the sugar, and (2) by fractionation whereby they accumulate in affination, " green " and wash liquors and finally in the molasses. Many abnormalities encountered in working the different runs of juice, as well as some abnormal properties of the final products, have been attributed to the presence of amino acids in the various stages of the processes. Among such abnormalities may be mentioned the foaming of massecuites in the hot room (froth fermentation), deterioration and discoloration of sugar during storage, low caramelization temperatures of certain white sugars, and the formation of gas causing the so-called "swells " in molasses containers. The

ordinary tests for amino acids are not applicable because of the very small quantities in which they are present in large masses of material. A very sensitive and characteristic test for them as a class of compounds would, therefore, be of service in studying and controlling them in the processes of sugar manufacture.

In 1910, Ruhemann[1] used triketohydrindenhydrate, which has been given the trade name of "Ninhydrin," as a delicate reagent for amino acids and related compounds containing a free amino group in the *a* position to a carboxyl group. From this reaction Abderhalden and Schmidt[2] developed a general method which became known as the Abderhalden test for amino acids. This method, however, soon proved unreliable and was discredited.

In 1922, Riffart[3] reinvestigated the reaction thoroughly and succeeded in finding the conditions under which accurate results may be obtained colorimetrically in dilute solutions, the maximum limit of dilution being 1 : 340,000. He also studied the action of Ninhydrin on a large group of substances which might interfere with the reaction, and showed that the reaction was specific for amino acids and related substances when working with very dilute aqueous solutions. His method has now been found applicable to the determination of amino acids in sugar, and, furthermore, for this type of work, a much simpler technique may safely be used.

The Simplified Method.

Solutions.—Prepare a master standard solution of aspartic acid by weighing accurately 0·4749 grm. dry pure aspartic acid, dissolving it in distilled water, and diluting to a final volume of 500 c.c. This master solution contains 100 mgrm. of nitrogen per litre; from it make the individual standard solutions by diluting 5, 10, 15, 20, and 25 c.c. to 100 c.c. with distilled water, forming solutions which contain 5, 10, 15, 20 and 25 mgrms. of nitrogen per litre. Preserve these standard solutions, and the master solution also, by covering their surfaces with toluene and keeping them in the refrigerator. Use a mixture of phosphates as a buffer: prepare two solutions of phosphates:— For solution A, dissolve 9·078 grms. of primary potassium phosphate (KH_2PO_4) in one litre of distilled water; for solution B, dissolve 11·876 grms. of secondary sodium phosphate *di*-hydrate ($Na_2HPO_4 \cdot 2H_2O$)[4] in a litre of water. Keep these solutions in stoppered flasks. Make the buffer solution itself by mixing two parts of A with three parts of B immediately before using, producing a solution having a *pH* of 6·976. Make a 1 per cent. solution of Ninhydrin just before using. (It may be purchased in vials containing 0·1 grms., and the solution is readily made by dissolving the contents of a vial in 10 c.c. of water. Care should be exercised in handling the solid or the solution, as it stains the skin blue.) Prepare also an approximately 50° Brix solution of pure granulated sugar.

Procedure.—If the material to be tested is solid, prepare a solution of about 50° Brix strength, and, if necessary, dilute it with the pure sugar solution to such an extent that there is present not more than 25 mgrms. of nitrogen as amino acids per litre. Because of the depth of the colour produced, it is practically impossible to make the final comparisons if solutions containing a greater concentration of nitrogen are used. If the material is a solution or a syrup, it may be used as it is, or it may be diluted as necessary with the pure sugar solution. It may be necessary to make a preliminary test

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[1] *J. Chem. Soc.*, 1910, 97, 2025. [2] *Z. physiol. Chem.*, 1913, 85, 143.
[3] *Biochem. Z.*, 1922, 131, 78.
[4] W. Mansfield Clark, "The Determination of Hydrogen Ions," Second Edition. (Williams & Wilkins Co., Baltimore, Md.) p. 109.

to indicate the degree of dilution needed. In general, solutions of high purity products may be used undiluted; all others require dilution, the extent of which depends roughly on the purity of the material. Blackstrap and refiner's syrup must be diluted to about 120 volumes.

In as many tubes as there are standard and unknown solutions, take 1 c.c. of each of the standard solutions of aspartic acid[1] and of the unknown solutions. Add to each tube containing the standard solutions 1 c.c. of the pure sugar solution, and to each of the unknowns 1 c.c. of distilled water. Mix the two phosphate solutions to form the buffer and add 2 c.c. to each test tube. Finally, add 1 c.c. of the freshly prepared 1 per cent. Ninhydrin solution and mix the resulting solutions well by shaking the tubes.

Place the tubes all together in a wire basket and heat them in a vigorously boiling water bath for one-half hour, at the end of which time the 5 mgrms. standard should have developed a decided blue-violet colour. In making this observation, remove the basket and all the tubes from the water-bath, in order that all the tubes may have exactly the same amount of heating. Uniformity in this detail is absolutely essential, as shown by RIFFART, and the standards with which a set of determinations is to be compared must be developed with the determinations in every case.

Allow the tubes to cool for one half hour after removing them from the water-bath, transfer the contents to measuring cylinders of colourless glass graduated in equal divisions, dilute to 100 c.c. with cold water and compare the unknown solutions with the standards colorimetrically. The percentage of nitrogen as amino acids can then be calculated directly.

DISCUSSION.

RIFFART[2] demonstrated that the inherent troubles with the Abderhalden method were attributable to variations in the *pH* of the solutions and in the heating of the reaction mixtures. He showed that the reaction must be carried on in a solution whose *pH* is practically 7, the neutral point. Accordingly, he employed a very elaborate means of neutralization of the solution, after which the neutrality was maintained by means of the buffer solution. In the neutralization of the solutions, extreme care is not necessary when working with normal sugar products, because the *pH* of the solutions is already relatively near the neutral point, and any slight variation from it is rectified by the buffer solution. Of course, if a liquor has fermented badly so that the *pH* has dropped excessively, or if a large amount of a very weak organic acid has been produced, causing a high total acidity without a great lowering of the *pH*, the solution should be neutralized before the test is made, as, under such abnormal conditions, the amount of buffer used might not be sufficient to restore and maintain neutrality during the reaction. A similar consideration shows that it is also unnecessary to use neutral water in making the solutions, but that ordinary distilled water will answer the purpose. A further argument against the elaborate neutralization when working with sugar and sugar products is the fact that in all cases except when testing high purity products, it is necessary to dilute the sample with the pure sugar solution, which results in lowering the concentrations of free acid or alkali present to such an extent that the buffer solution itself is generally strong enough to neutralize the solution.

Two solutions of aspartic acid were prepared, each of which contained 10 mgrms. of nitrogen per litre. One solution was exactly neutralized

[1] In withdrawing the solution with a pipette, be careful that no toluene is withdrawn with the solution.
[2] *Loc. cit.*

according to RIFFART's directions; the other solution was not neutralized; both were then tested by the method given above. The colours of both solutions were identical and corresponded to the standard containing 10 mgrms. of nitrogen per litre. RIFFART overcame the error caused by non-uniform heating by developing the colour in the standards simultaneously with that of the solutions to be analysed, a new set of standards being used with each set of determinations. His technique is so simple that no modification is needed for sugar analyses.

The colour produced by the Ninhydrin reaction with amino acids is blue-violet, while that produced with carbohydrates is yellow. RIFFART points this fact out as a source of error in his method when analysing solutions containing sugar, as the yellow colour of the sugar reaction changes the hue and darkens the shade of the amino acid reaction, making it difficult to match the final colours, and causing a large positive error in the value determined. This objection is overcome by introducing sugar into the standard solutions, so that the hue and shade produced in them correspond in quality or " tone " to those of the unknown sugar solutions. There is no need to attempt to adjust accurately the concentrations of sugar between the standards and the other solutions, since the yellow colour does not vary appreciably in depth with changes in the concentration of sugar. A solution of glutaminic acid containing 20 mgrms. of nitrogen per litre was prepared and tested in the presence of sugar.

N taken mg.		N found mg.		Error[1] Per cent.
0·020	....	0·018	....	—10
0·010	....	0·009	....	—10

The magnitude of the error is not too great for the purpose under consideration. If greater accuracy is desired, the exact neutralization described by RIFFART may be resorted to, but for ordinary sugar work the shorter method is accurate enough. The presence of relatively large amounts of dextrose does not interfere with the accuracy of the method. Two 50 c.c. portions of the master solution of aspartic acid (containing 5 mgrms. of nitrogen) were taken, to each was added 1 grm. of dextrose. One of these was made alkaline by diluting it to 100 c.c. with a 0·05 molar solution of sodium carbonate (pH about 11); the other was diluted to 100 c.c. with the neutral buffer solution used in the analysis. In order to facilitate the establishment of equilibrium between the dextrose, the amino acid and their reaction products at low temperature,[1] the solutions were allowed to stand at 40°C. for 42 hours. After cooling, 2 c.c. of each solution were diluted to 5 c.c. with the 50° Brix sugar solution. This gave solutions which contained 0·02 mgrms. of nitrogen and 4 mgrms. of dextrose per c.c.

	N taken mg.		N found mg.
Alkaline solution	0·02	..	0·02
Neutral solution	0·02	..	0·02

(To be continued.)

The imports of sugar into Switzerland during the first six months of the 1926-27 campaign amounted to 54,416 metric tons, as compared with 66,123 tons in 1926. The amount coming from Czecho-slovakia was very much less, due to high transport charges on the sugar, and German and Belgian sugar figured in consequence for much larger amounts. Incidentally, an import of 45 tons of English sugar furnishes the first instance where England has figured in the Swiss sugar imports.[2]

[1] RIFFART reports an error of +5 per cent. in determining glutaminic acid with standards made with aspartic acid, without sugar.

[2] Report of BRUNNER and BOSER, Schaffhausen.

Publications Received.

The Microbiology of Cellulose, Hemicelluloses, Pectin, and Gums. A. C. Thaysen and H. J. Bunker. (Humphrey Milford, Oxford University Press, London.) 1927. Price : 25s. net.

Cellulose decomposition by the agency of micro-organisms is a subject in which considerable interest has been shown within recent years. In our industry it opens up the possibility of the profitable utilization of surplus bagasse for the production, for example, of a preparation having properties similar to those possessed by farmyard manure, and also the possibility of the production of ethyl or ether alcohol by a process of direct fermentation. This book presents a well-compiled survey of our present knowledge of the micro-biology of cellulose and the other polysaccharides. It is divided into four parts : (1) Cellulose, hemicelluloses, pectin and gums ; (2) types of micro-organisms associated with the decomposition of cellulose, etc. ; (3) microbiological decomposition processes of cellulose, etc. ; and (4) industrial applications. Perusal of its chapters impresses one with the great mass of literature on the subject that has now accumulated, indicating the desirability for a book such as this. There is a brief outline, rather too brief a one it seems, on the work done by various investigators on the micro-biological decomposition of celluloses in the manure heap, and on that carried out at Rothamsted by HUTCHINSON and RICHARDS on the preparation of artificial farmyard manure. Turning to the other development of great potential interest, viz., the production of power alcohol by the direct fermentation of vegetable matter, it is shown that under certain conditions at least one type of hemicellulose, as well as pure cellulose, may be converted into ethyl alcohol. But how far lignified cellulose (which of course constitutes by far the largest part, if not all, of the readily accessible vegetable waste materials) can be similarly converted has not yet been established.

The Chemists' Year Book, 1927. Edited by F. W. Atack, M.Sc., D.Sc., F.I.C. (Sherratt & Hughes, Manchester.) 1927. Price : 21s. net.

In this the 12th edition of ATACK's " Year Book," some further revision, elimination and extension of matter has been effected. As we have remarked when reviewing previous editions, it is a very valuable general reference work for the chemist, containing as it does an immense amount of carefully sifted information in a readily accessible form. Data on physico-chemical constants, on general properties of inorganic and organic compounds, qualitative analysis (dry-way test, solution analysis, etc.) the preparation of reagents ; volumetric analysis ; gas analysis ; methods of analysis used in various industries ; chemical invention and the law of patents ; conversion tables, tables of solubility, hydrometric tables, mathematical constants, 5-figure logarithms, etc., etc., are here to be found in condensed form. Regarding the section on " Carbohydrates " we repeat our remarks of last year to the effect that this is a disappointing section, as it does not outline methods used in the technical and commercial analysis of cane and beet sugar products, and it seems urgently to require revision. Notwithstanding this, it can very fairly be said that the book should be at hand in every laboratory.

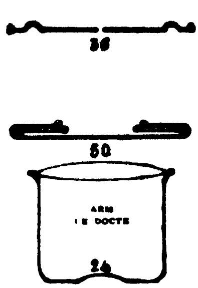
The Determination of Sulphur Dioxide in Foods. G. W. Monier-Williams. Reports on Public Health and Medical Subjects, No. 43. (H.M. Stationery Office, London.) 1927. Price : 1s. 3d.

Dr. MONIER-WILLIAMS is in charge of the Chemical Laboratory of the Ministry of Health. In connexion with the Public Health (Preservatives, etc., in Food) Regulations he has undertaken to review the literature on the determination of sulphur dioxide, and finally has suggested a general method. He has prepared this Report, not with the view to imposing any special methods of analysis under the Regulations, but rather for the purpose of providing information which may be useful and timely to analysts concerned with the examination of foods. His report indeed forms a very thorough monograph on the subject, containing carefully compiled data on the many methods that have been proposed for the testing and determination of SO_2. It is certain to be welcomed by sugar factory and refinery chemists, and is dealt with elsewhere in this Journal.

Review of Current Technical Literature.[1]

SACHS-LE-DOCTE *vs.* THE KRÜGER METHOD FOR DETERMINING SUGAR IN THE BEET. **Arm. Le Docte.** *Note communicated to this Journal* (abridged).

This communication is supplementary to the article already published,[2] in which it was explained why inaccurate results are given by the Krüger method, and it is written in reply to a correspondent who had drawn attention to the comparative experiments carried out by HERZFELD on the S.L.D. and Krüger methods,[3] the two being shewn there to give practically the same result (as the average of 33 analyses). It was stated in the previous article that Krüger's method is subject to a fundamental source of error, arising from the addition of 78 c.c. to 26 grms. of rasped beet, this being wrong from two points of view : (1) there is too high a proportion of liquid per 26 grms. of beet (i.e., 78 c.c. instead of 77 c.c.); and (2) there is too small a volume per 26 grms. of pulp, i.e., 100 c.c. in place of 200 c.c. It is, however, evident that when making a few comparative analyses the other defects of the Krüger method may be avoided by working with special care and by giving the necessary time. But this cannot be done in the case of routine analyses which have to be carried out rapidly and in great number, by operators who often are not trained chemists, and even may be only assistants who execute mechanically the tasks entrusted to them. It is therefore of the very greatest importance that the various operations should require only the least possible attention and care on the part of assistants, so that even some negligence by them may not have any appreciable consequence. But even if when carrying out a few comparative determinations between two processes the final result should be the same, that does not at all prove that one process should be recommended quite as as well as the other, because actually one may be irreproachable and the other bad in every respect. Thus for example, suppose there are the following errors in the case of the latter : (1) an inexact weighing either due to a bad balance or to a faulty normal weight, this giving say 0·1 per cent. too much sugar; (2) a piece of root inexactly sampled, also giving 0·1 per cent. too much ; (3) a pipette measuring a volume of liquid 0·1 per cent. too little ; and (4) an insufficient mixture, also giving 0·1 per cent. too little. Hence one will have four errors in these operations, of which two are plus and two are minus, these compensating one another exactly, yet the final result will be identical with that given by the first method, obtained by operations executed with absolute exactness. In order that a process shall be beyond criticism, giving irreproachable results in all circumstances, it is necessary that at all stages operations can be made without error, identical directions being always followed. But this is just what is not so with the Krüger method, the several different methods of operating which are all to be rejected; and on the contrary it is just the case with the Sachs-Le-Docte method, all the details of which have been minutely studied. It is for this reason that the S.L.D. process always gives such exact and constant results with the maximum of rapidity and the minimum of attention on the part of the operator. In Germany, methods of determining sugar in the beet by hot alcoholic digestion and by cold alcoholic diffusion, both giving low results, were long conserved in use, and similarly the Krüger method is favoured by the managers of sugar factories in Germany. Lastly, it is not possible to find the same results with the Krüger and the S.L.D. methods, so long as in the latter 78 c.c. of liquid are added to 26 grms. of pulp, which in the case of a beet having 16 per cent. of sugar means a difference of 0·16 per cent. If this difference is not acknowledged, it is irrefutable proof that the comparative determinations between the two methods have not been carried out exactly and seriously. In Herzfeld's determinations it is not certain that all the directions of the S.L.D. method were rigorously followed.



[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, I.S.J.

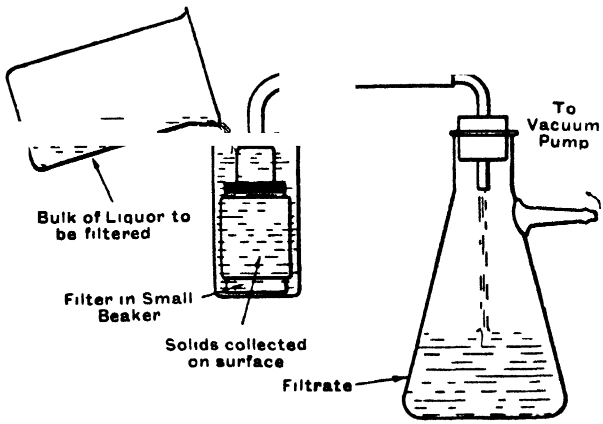
[2] I.S.J., 1927, 214.

[3] Zeitsch. Ver. deut. Zuckerind., 59, 627; see C. A. BROWNE, "Handbook of Sugar Analysis," pages 244-245.

[4] See also I.S.J., 1927, 109.

"STREAM-LINE" LABORATORY FILTER. *From particulars communicated to this Journal by the Stream-Line Filter Co., Ltd., London.*

Some details of the "Stream-Line" filter, invented by Dr. H. S. HELE-SHAW, and also some information regarding further developments[1] have already been given. A description has also been given of experiments carried out by C. F. ARMSTRONG in Guatemala in 1925 on the filtration of defecated juice using the same apparatus, results having been obtained in this direction on the large scale which would have been impossible in the ordinary way. It is of interest to chemists in our industry to note that a laboratory apparatus has now been put on the market, which should prove to be a very handy and rapid means of demonstrating the principle of edge-filtration, and should enable factory and refinery chemists to carry out useful experimental work on the removal of particles in coarse dispersion, and to some extent substances in colloidal solution. It consists of two parts, a spigot on which is placed a number of paper rings (of standard size, so that the results obtained



can be translated to a larger scale apparatus by simply multiplying their number), and the suction unit, which is screwed to the spigot, compressing the rings to any desired degree. As is shown in the illustration, the filter is immersed in a beaker containing the liquid to be filtered, attached to the filter flask and vacuum pump, then the full vacuum turned on at once. The filtering beaker is kept filled up, and when all the liquid has been poured in, the whole amount is caused to pass through the filter by tilting the beaker and turning the filter back and forward, wash-water if desired being employed at the final stage to clean the filter; the solid is detached from the filter-flask by a puff of air blown by means of a bicycle pump down the suction tube, when the residue drops off and the filter is ready for further use. When it is desired to change over from filtering one aqueous liquid to another, the filter can be simply attached to the tap, leaving water to run backwards through it, which cleans and washes it very thoroughly. This laboratory "Stream-line" apparatus may be used for operations for which Buchner funnels are employed; for filtrations which are difficult owing to the fineness of the precipitate; or for filtrations dealing with a large bulk of liquid with only a trace of suspended matter. It is a filter which merits inclusion in any properly equipped laboratory for a number of useful applications in everyday work.

CLARIFYING STARCH CONVERSION LIQUORS IN THE MANUFACTURE OF CORN SYRUP AND CORN SUGAR. **M. S. Badollet and H. S. Paine.** *Paper presented to the Division of Sugar Chemistry, American Chemical Society, Richmond, Va., April,* 1927.

An improved procedure for clarifying starch conversion liquors in the manufacture of corn syrup and corn sugar has been devised[1]. Whereas the colloidal material in most sugar liquors, in common with most colloidal suspensions in water, bears

[1] *I.S.J.*, 1923, 628; 1925, 162, 218, 330 and 333.

a negative electric charge, the colloid particles present in starch liquors converted by acid bear positive electric charges, probably as a result of the unusually high hydrogen ion concentration of such liquors. These liquors may, therefore, be clarified by mutual colloid flocculation by the addition of colloidal material bearing an opposite electric charge in this medium. The starch conversion liquors before being neutralized with sodium carbonate may be treated with an aqueous suspension of such materials as certain colloidal clays and earths or other colloids which carry a negative charge when present in such liquors. For example, such substances as bentonite, colloidal aluminates, colloidal alkaline compounds of iron, silicates of alumina, etc., in aqueous suspension produce an excellent flocculation and elimination of colloids. Also, such substances as bauxite or pure aluminium oxide, when dispersed in alkaline solution, cause greater flocculation than the customary neutralization with sodium carbonate. The material flocculated by these reagents should be removed by filtration or sedimentation before the liquor is subsequently neutralized with sodium carbonate. In the use of colloidal clarifying reagents bearing a negative electric charge, it is best to continue addition of the reagent until the iso-electric point of the conversion liquor is reached. This may be determined by ultramicroscopic cataphoresis measurements.[1] The quantities of reagent required to cause increased flocculation of colloidal material, as compared with that produced by sodium carbonate, are very small. A bentonite clarification as compared with a sodium carbonate clarification gives as high as a 258 per cent. increase in colloid elimination. Other clarifiying agents which bear negative electric charges in acid conversion liquor cause an increase in colloid elimination. Improved clarification of conversion liquor makes possible the production of corn sugar crystals of increased size and facilitates centrifugal work.

Adsorption of Raw Cane Sugar Colloids by Bonechar. **H. S. Paine and M. S. Badollet.** *Paper presented to the Division of Sugar Chemistry, American Chemical Society, Richmond, Va., April,* 1927.

A recent investigation by the authors of bonechar filtration of sugar-liquors in a raw cane sugar refinery indicated that used bonechar has preferential adsorption affinity toward the water-irreversible type of raw sugar colloids as compared with those of water-reversible character, although in all cases both types of colloids are adsorbed. This work has been rechecked by laboratory experiments, using sugar-free colloidal material separated from raw sugar by ultra-filtration. These tests were made on a variety of types of bonechar and gave results which indicated that new bonechar (not previously used for a sugar-liquor filtration) has preferential adsorption affinity for reversible colloids. When new bonechar is placed in process and re-used several times, it apparently loses its property of preferential adsorption of reversible colloids and adsorbs irreversible colloids to a greater extent than those of reversible type. This is probably due to a change in the specific adsorption character of the surface of the bonechar particles. Since reversible colloids are eliminated to only a negligible extent by lime defecation in raw sugar manufacture and dependence must be placed upon carbon to remove this type of colloids, it is desirable that bonechar be revivified under conditions which will maintain its adsorption affinity for reversible colloids at approximately the level of new (unused) bonechar. This phase of the subject is being investigated further by the authors. It has been observed that colloidal material "leaches out" of the bonechar as soon as the density of the sugar liquor drops during the "sweetening-off" process. This is apparently due to a change in adsorption equilibrium. In view of its colloid content, it is suggested that bonechar sweet-water be handled as a separate unit instead of returning to the washed raw sugar melter or boiling into remelt sugars which are returned to the raw sugar bin to be washed together with the raw sugar. This can be accomplished by evaporating the bonechar sweet-water to syrup and mixing with other liquors of higher colloid content than raw sugar melt which are filtered through either medium or low grade bonechars. In this manner the adsorption activity of the bonechar used for high grade sugar liquors will be maintained at a higher level for a longer time.

[1] See *I.S.J.*, 1926, 25, *et seq.*

Ash Determination in Sugars Electrically, and the Specific Conductance of their Solutions. F. W. Zerban and L. Sattler. *Facts about Sugar*, 1926, 21, No. 49, 1158, 1162-1166.

A conductivity cell was constructed similar to that of Tödt[1], and based directly on the specifications given by Lange in 1910[2]. It has a water-jacket fused on, in order to enable the operator to work at 20° C. Its constant was found to be approximately 0·15 reciprocal centimetre. The measuring equipment employed consisted of a microphone hummer operated by 4 dry cells, a students' Kohlrausch slide-wire bridge, a resistance box with a total of 9,999 ohms, variable in steps of one ohm, and a tunable telephone receiver. Duplicate determinations of resistance, using different bridge settings with the extension coils switched in, checked within 0·1 to 0·2 per cent. Three different settings were made and the average result was used. Two other "set-ups" for measuring specific conductance were used for comparison of results. One of these consisted of a dial type Wheatstone bridge and an alternating current galvanometer, this giving results in very close agreement with the standard set. The other comprised a portable conductivity indicator with an alternating current galvanometer incorporated in it. This had a slide-wire with its scale directly calibrated to indicate the ratio between the two bridge arms, with comparison resistance coils of 1, 10, 100, 1,000, and 10,000 ohms. This equipment gave in some cases somewhat wider variations, evidently because the settings could not always be made near the centre of the bridge. Both equipments were used directly on a lighting circuit of 110 volts 60 cycles. Altogether 221 samples of Cuban, Philippine, Dominican, and British West Indian sugars were examined by the electrical and gravimetric methods, the conductance being measured on solutions containing 5 grms. in 100 c.c., using a cell similar to Lange's[3], while the ash was determined also in water-soluble portions by the usual sulphate method, deducting 10 per cent. from the result. It was found that there are considerable variations in the ratio of ash to conductance (ratio *C*), not only for individual plantations, but also in the averages for different countries or provinces of a country. Nevertheless in 84 per cent. of all the samples examined the difference between the ash found and that calculated from the average ratio for each geographical division is within 0·02 per cent. on sugar, and in 93 per cent. of all samples within 0·03 per cent. But in some there are discrepancies as much as 0·04 to 1·0 per cent.; and conductimetric titrations have shown these to be due to differences in the composition of the salts contained in the sugars, particularly to differences in the proportion between inorganic and organic anions.

Data of the La Carlota Central P.I. for 1926-27.[4] H. Gifford Stower. *Communicated to this Journal by the La Carlota Sugar Central, Negros Occ., P.I., dated May 5th*, 1927.

Commencement of crop, November 3rd, 1926; termination, April 7th, 1927; possible working days, 133; days of 24 hours, 126; days of 24 hours worked, 123; average of hours worked per working day, 22; average of hours worked per day of 24 hours, 23; time lost due factory, 34; time lost due to want of cane, 38; based capacity of mills, tons, 3000; average milled per working day, tons, 3480; average milled per day of 24 hours, tons, 3673; average milled per 24 hours worked, tons, 3763; sacks of 126·8 lbs. produced: average per working day, 7410; Sacks of 126·8 lbs. produced: Average per day of 24 hours, 7822; sacks of 126·8 lbs. produced: Average per 24 hours worked, 8012; total sugar manufactured, sacks of 57·5 kilos net, 985,527; total sugar manufactured, tons, 56,667; total cane milled, tons, 462,840; average purity of crusher juice, 86·07; fibre in cane, average, 10·37; tons of cane per ton of sugar, 8·17; total number of cars loaded, 111,865; average weight per car, 4·14; acres cropped, 26,914; average tons of cane per acre, 17·20; hectares cropped, 10,892; average tons of cane per hectare, 42·49; average extraction in mills, 94·66. These figures therefore form a record for the Philippines both in quantity and rate of milling.

[1] *I.S.J.*, 1925, 503. See also *I.S.J.*, 1925, 671; 1926, 136, 364, 440, 560. [2] *I.S.J.*, 1910, 423.
[3] *Loc, cit.*
[4] See also *I.S.J.*, 1926, 441, and previous yearly Carlota Reports.

PRODUCTION OF FAT BY A PENICILLIUM IN SUCROSE SOLUTION. **Harold Hayden Barber.** *J.S.C.I.*, 1927, **46**, No. 20, 200T. Each culture flask containing 500 c.c. of medium (consisting of a 5 per cent. of sucrose plus various inorganic nutrient salts) gave an average yield of 3·4 grms. of dry residue, which contained about 14 per cent. of fat.[1] The *Penicillium* was isolated from various moulds found growing on a starch mixture from lace-finishing works, It produced vivid red-coloured colonies on starch paste, and turned sucrose solution red.—ENSILAGE OF SUGAR BEET TOPS. **H. E. Woodman and A. Amos.** *Journal of Agricultural Science*, 1926, **16**, Pt. 3, 406. Tables are given showing the composition of beet tops both before and after ensiling, and that of sugar beet tops in comparison with wheat chaff and with a silage made from a mixture of beet tops and wheat chaff. It is doubtful whether the ensiling of sugar beet tops would be a paying process owing to : (1) the difficulty and expense of carting the tops, and transferring them into a tower silo ; and (2) the fact that at the season of cutting the tops the silo is frequently full, and the contents are ready for being fed to stock. The most economical method of utilizing the tops is to allow sheep or cows to eat them directly off the land, or in the case of large areas, where it may not be possible for the whole of the tops to be consumed before decomposition commences, to plough them in as manure.—TINLESS CANS (FOR FRUITS, SYRUPS, ETC.). **E. F. Kohman and N. H. Sanborn.** *Industrial and Engineering Chemistry*, 1927, **19**, 514. It was not proven that tin intensifies the corrosion of iron in certain canned goods because of the electric couple set up between them, the nett conclusion of the investigation being that tinned cans are more serviceable than tinless from the commercial standpoint. Lacquers may be developed which for certain products will make the use of tin unnecessary.—DETERMINATION OF PHOSPHATES IN JUICE. **H. B. Springer and J. G. Davies.** *Journal of the Society of Chemical Industry*, 1927, **46**, No. 14, 143-144T. Uranium acetate method (as used by WALKER[2]) gives too low results, but more reliable figures are given by the Pemberton-Neumann molybdate process,[3] even in the presence of silicates in concentrations such as may occur in raw juice.—NIPA PALM PRESERVATION. **J. H. Dennett.** *Malay Agric. J.*, 1912, **12**, 375-383, through *J.S.C.I.*, 1927, **46**, 15, 263. Figures for yields per month for 20 months, and the effect of tapping on the fruiting of the palms, are given. Addition of sulphuric acid, so as to produce a concentration of about 0·25N, caused inversion of all the sugar in about 20 hours, but after that the sugar content remained constant over a period of three days ; whereas, in weaker concentrations, fermentation had proceeded rapidly.—USE OF KIESELGUHR ("HYFLO-SUPERCEL") AS FILTER-AID. **Edward J. Sullivan.** *Facts about Sugar*, 1927, **22**, No. 3, 65. Tests made in Cuba show the use of this filter-aid results in advantages that more than pay for the small cost of the material (0·3 to 0·5 cent per ton of cane). Pressures as high as 70 lbs. had been necessary previously, and a saving in cloth, labour, lime, steam, had been proved. Especially was it possible constantly to run the mill at maximum capacity, so far as the filtration department was concerned.—DEVELOPMENT OF FLOWERS AND SEED IN THE SUGAR BEET. **Ernst Artschwager.** *Journal of Agricultural Research*, 1927, **34**, No. 1, 1-25. This article studies the general development of the flower of the beet, and the relationship of the leaf and floral traces.—CONSTITUENTS OF THE SUGAR CANE. **H. Colin.** *Sucrerie Belge*, 1926, **45**, No. 16, 301-310. A review of our knowledge of the composition, constitution, and synthesis of the sugars of the cane.—CORROSION OF GOLD-PLATED WEIGHTS. **Anon.** *Technical News Bulletin*, 1927, **119**, 5. Many gold-plated weights of the common screw-knob type vary by excessive amounts with the humidity of the atmosphere, this defect being found to be due to the presence of salts or corrosion products from the plating liquid. It can be avoided by thoroughly washing and boiling the weights in water with the knobs removed, paying special attention to the cleaning of the cavity, and changing the water more than once.[4]

J.P.O.

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[1] This is a yield of about 2 grms. of fat per 100 of sucrose.

[2] *I.S.J.*, 1923, 214.

[3] "The Theory of Quantitative Analysis and its Practical Application." 1925.

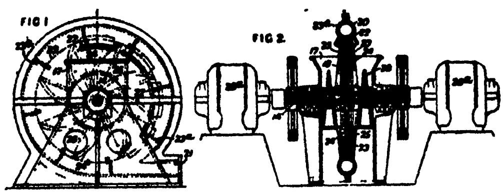
[4] See also *Technical News Bulletin*, 1926, 115.

Review of Recent Patents.[1]

UNITED KINGDOM.

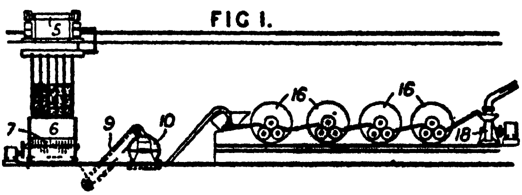
SHREDDING AND MILLING CANE. **William Henry Morgan, Sr.**, of Alliance, Ohio, U.S.A. (*A*) 266,841; (*B*) 267,234; (*C*) 267,235. December 14th, 1925.

(*A*) In shredding cane, it is fed in short lengths into hoppers 17, from which it is carried by worm conveyers 28 into the spaces between a middle rotating disc 23 and stationary discs 18. Each disc 18 forms one side of a hopper 17 and is coned so that the space between it and the rotating disc is greater at the centre than at the periphery. Curved blades 24 are secured in recesses in the disc 23 and co-operate with straight radial blades 25 secured in the discs 18, the blades being adjusted



with their cutting edges approximately in contact. The stalks of cane are so guided in their passage to the knives that they are presented for the cutting operation with their long axes perpendicular to the shaft of the rotary disc and are so cut lengthwise. The edges of the fixed discs are shaped to form a circular channel 20 into which the shredded cane is forced by centrifugal action and along which it is pressed by blades 23*a* secured to the rotary disc 23. The channel 20 leads to an outlet 21. Air inlets 22 are formed in the stationary discs. The shaft 14 carrying the rotary disc is driven by motors 28*a*.

(*B*) In milling cane, it is cut into short sections which then are shredded longitudinally during longitudinal movement thereof between relatively movable blades to produce a fibrous finely-shredded absorbent mass from which the juice can be extracted by expression or diffusion. The shredder is preferably constructed as described in the previous specification, and by arranging that the shreds and the juice are confined during the shredding, juice liberated therein is reabsorbed by the sponge-like absorbent mass. In the example described, the canes are delivered by a travelling crane 5 to the hopper 6 of a multiple saw 7 where they are cut into sections of about 6 in. in length, which are passed by a conveyer 9 to a shredder 10 which consists of two stationary discs having radially disposed shredding blades

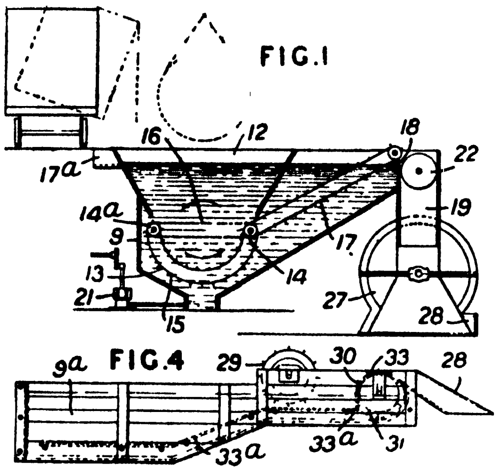


on their inner surfaces with which similar blades on opposite sides of a central rotating disc co-act. The shaft of the central disc may be driven by one or two motors; where two motors are employed, one at each end, each may be capable of driving the disc alone. The spaces between the discs are of such a size that the cane sections enter and are guided into position so as to be substantially radial to the shaft during shredding. The shredded cane passes to a series of expression

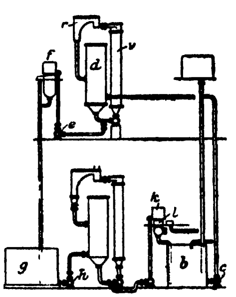
[1] Copies of specifications of patents with their drawings can be obtained on application to the following—*United Kingdom*: Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C 2 (price 1s each). Abstracts of United Kingdom patents marked in our Review with a star (*) are reproduced from the *Illustrated Official Journal* (*Patents*), with the permission of the Controller of H.M. Stationery Office, London. Sometimes only the drawing or drawings are reproduced. *United States*: Commissioner of Patents, Washington, D.C. (price 10 cents each). *France*: Imprimerie Nationale, 87, rue Vieille, du Temple, Paris. *Germany*: Patentamt, Berlin,

rollers 16, from the last of which the bagasse, now comparatively dry, may be blown as fuel into the firebox of a boiler by a fan 18. When the juice is extracted by diffusion it is easily removed from the cells, which are broken in the shredding, and the wax and other impurities adhere to the fibres giving a purer extract.

(*C*) Previous to extraction, cane is washed and cut into short lengths, which are reduced to a fibrous hay-like mass. In one form, Fig. 1, the canes are fed to the arrows, by a conveyor 13 so that their waxy covering substance and the sand and other dirt are rubbed off. The conveyor 13 is formed of a series of looped, preferably sprocket, chains having gripping fingers 15. The chains are mounted on shafts 14, 14*a*, shaft 14 being driven, e.g., by a motor, and shaft 14*a* being driven from shaft 14 by a belt or chain 16. Water or other washing fluid is supplied to the tank 9, leaves, etc., being removed through an overflow 17*a*. The sludge is removed from the bottom of the tank 8 by a pump 21. A conveyor 17, preferably mounted on shaft 14, and similar to conveyor 13, raises the cleaned canes in a hopper 18 containing circular saws 22, which cut the cane into lengths of about 6 in. The cut sections fall through a hopper 19 to a disintegrator 27, where they are shredded longitudinally to a fibrous hay-like mass, which may be fed by an air-blast through outlet 28 to the mill rollers. Instead of extracting the juice immediately, the fibrous mass may be dried, bundled, and stored for extraction later, and in this condition can be transported to a central factory. Another form of the washing apparatus is depicted in Fig. 4.



Recovery of Sugar from (Beet) Molasses. **L. Steffen (née Jelinek)** of 75, Taborstrasse, Vienna. 266,187. June 11th, 1926. Saccharate obtained in the second precipitation is separated by filter-pressing, mashed with dilute molasses solution, and the soluble sugar-lime compound produced precipitated as insoluble saccharate by lime. The molasses is first diluted with water in container *b* and forced by pump *c* into precipitation apparatus comprising a cooler *v*, a container *r* in which powdered lime is added, and a precipitation chamber *d*. The saccharate produced is separated in filter-press *f*, and the liquor passed to container *g* from which it is forced by pump *h* into a similar precipitation apparatus where the sugar remaining in solution is precipitated by excess of lime. The tricalcium saccharate produced is separated in filter-press *k*, the liquor passing to waste, and is next mashed in receptacle *l* with fresh dilute molasses and passed to container *b* where it is mixed with a further amount of diluted molasses, the mixture being passed to the precipitation apparatus *d*, *v*, *r*. The amount of lime now required for precipitation is less than formerly owing to the higher activity of lime liberated on mashing the saccharate with the molasses.—Production of Citric Acid from Sucrose, Etc. **A. Fernbach, J. L. Yuill, and Rowntree & Co., Ltd.,** of York. (*A*) 266,414. October 26th, 1925. (*B*) 266,415. October 26th, 1925. (*A*) The production of citric acid from solutions of sucrose by means of moulds of fungi is carried out without sterilization of the solution by heat but with the addition of hydrochloric acid to the



solution, the amount of acid added being such as to establish a hydrogen-ion concentration at which the selected organisms can be grown to the virtual exclusion of invading organisms, a suitable value being *pH* 1·8. (*B*) Specification 266,414 is extended in that (1) it is applied to the treatment of sucrose, invert sugar, glucose, levulose, maltose, other suitable carbohydrates, and glycerol, or mixtures thereof; and (2) not only hydrochloric acid, but other mineral or strong organic acids or mixtures thereof may be added to the solution.—DIMINISHING CARBOHYDRATE LOSS IN PLANTS WHEN STORED. **Chemische Fabrik auf Actien, vorm. E. Schering,** of Berlin. 266,695. February 26th, 1926. To diminish or to prevent the loss of carbohydrates in plants when stored, the part containing carbohydrate is treated with an agent acting as a narcotic preferably in the form of a vapour or gas. Chloroform, ethylene bromide, toluene, acetic ester, ethylene, acetylene, carbonic acid, carbonic oxide, generator or water gas may be used either alone or as mixtures. Other materials may be mixed with the narcotic agent. As a specific example sliced chicory roots are, whilst still having their greatest content of inulin, treated in an airtight container with about 0·1 per cent. by weight of chloroform. The inulin may be obtained by any ordinary process such as the diffusion process even after months of storing.—SILICATE FILTER-AID, ETC. **A. J. Haddan** (communicated by **Celite Co.**, of Van Nuys Buildings, Los Angeles, U.S.A.). 268,011. December 18th, 1925. A voluminous almost gelatinous mass of hydrated calcium metasilicate is produced by treating finely ground silica (diatomaceous earth, etc.) with lime oxides or hydroxides of magnesium, strontium, or barium in the presence of water, with or without heating. The product is dried and pulverized, or the wet mass may be calcined and carbonated during or after calcination. It may be used in the form of a slurry or thick suspension as a decolorizing material or a filter-aid for beet, and cane sugar liquids, fruit juices, syrups, etc. If used as a filter-aid for an aqueous liquid, the diatomaceous earth and lime mixture may be boiled in a portion of such liquid. Or it may be used as an absorbent for gases, moisture or liquids and malodorous substances, as a lubricant, or for heat insulation, or in de-emulsification, as an ingredient in concrete and cement, a filler, etc., etc.—FILTER. **R. Haddan** (communicated by **The Oliver Continuous Filter Co.**, of Oakland, Cal., U.S.A.). 270,108. June 11th, 1926. In filters having sheet filtering-materials, tubular filter elements suspended in a tank containing material to be filtered and kept clear by the periodic introduction of air or gas under pressure, have filtering material covering the whole length of the tubes and inner depending tubes which secure that a quantity of liquid within the tubes is driven outwards before the gas passes out.—DEHYDRATING ALCOHOL. **U.S. Industrial Alcohol Co.** (assignees of **D. B. Keyes**). 268,728. November 29th, 1926; convention date, March 30th, 1927. In dehydrating alcohol by distillation in presence of an added liquid such as benzol, ethyl acetate, carbon tetrachloride, hexane, etc., yielding a ternary azeotropic mixture which on condensation separates into two layers, the layer consisting mainly of the added liquid is subjected to distillation so as to obtain the pure liquid which is used again.—PRODUCTION OF POTASH FROM BEET VINASSE OR DISTILLERY SLOPS. **R. Goldschmidt,** of Tavikovice, Czecho-Slovakia. 268,790. March 30th, 1927; convention date, March 30th, 1926. A process for obtaining concentrated potassium solutions from distillers' mashes consists in centrifuging the fermented residues at such a speed that the suspended matter comprising yeast cells, nitrogenic and other compounds is separated off into a semi-solid or solid mass which may be admixed with bran, linseed cake, etc., to form a fodder. Clean centrifuged liquor containing potassium salts is used again for preparing new mash and the process is repeated so long as the concentration of salts does not interfere with the normal fermentation process and the concentrated salts may be worked up into potash.—DIGGING BEET. **H. D. de la Cour,** of Holmegaard, Denmark. 269,030. July 27th, 1926. In a machine for digging beet, in order to prevent damage of the roots, the lower rear part of the lifting shares is curved, the rest of the share being flat. The shares are attached to a bar secured to a main frame that is carried by vertically adjustable steering wheels and main wheels.

UNITED STATES.

PURIFICATION PROCESS (NEUTRALIZATION OF COLLOIDS WITH IRON TANNATE AS COLLOIDAL SOL). **Charles B. Davis**, of New York. 1,618,148. February 15th, 1927.

Distinctive features of the invention consist in effecting coagulation and precipitation of deleterious matter from solutions containing carbohydrates, by the introduction in suitable proportions of colloids of opposite electrical polarity to effect the neutralization of the colloids initially present in the solution, the specific use of a colloidal tannate of iron, an extremely active colloid for the purpose, being claimed. When a soluble tannate and a soluble iron salt (both crystalloids) are brought into contact with each other, a soluble active colloidal solution of tannate of iron is produced possessing a negative charge of electricity. If this comes into contact with a positive charged colloid, such as the yellow coloured constituent of raw sugar or syrup, it causes it to coagulate and can now be removed by filtration, due to the fact that the two charges of electricity (electronic action) have become neutralized and are no longer in the colloidal state. Heretofore, in sugar refining particularly, the elimination of colouring matter and impurities from the saccharine solution preparatory to crystallization has been a difficult and tedious problem, but the desired result can be attained by practically a single operation, thereby saving time and labour in manipulation, simplifying the apparatus involved, and reducing cost of manufacture to an extent equivalent, approximately, of from 5-10 per cent. per lb. of product. Thus for convenience of illustration, the preferred treatment of one ton of raw sugar dissolved in water to a density of 30° Bé. is as follows : To this slightly acid solution 3-5 grms. of a colloidal tannate of iron may be added, together with about 1 lb. of diatomaceous earth, and the whole syrup will be segregated therefrom, and on passing this through a char filter, gives a water-white liquid, which on boiling in a vacuum pan, etc., gives perfectly refined, crystalline sugar of the highest commercial grade and value. Since raw sugars vary in colour content, of intense tinctorial power, and impurities, the quantity of colloid of opposite electric polarity to be added to the solution must be in proportion to the initial colloids contained therein, as less or more than the requisite equivalent would prevent coagulative action. Hence, the importance of ascertaining the proper quantity of colloid of opposite electric polarity to be added to a saccharine solution to be thus treated, which may be accomplished in the following manner. For instance, to ascertain the requisite amount of negative colloid to be added to aforesaid colloidally opposite solution of 1 ton of sugar, the following means and formula may be utilized : (A) Six glass tubes, 4 ft long × about $\frac{3}{8}$ in. inside diam. and drawn out to $\frac{1}{8}$ in. bore at one end, are supported in a stand and each partly filled with 100 grms uniform char of 20/40/60 mesh, and having a piece of cotton wool in bottom to hold the char in place. (B) 700 grms. raw sugar and 500 grms water together with 25 grms kieselguhr, is heated to 160° F. until all sugar is in solution, and then filtered clear; 100 c.c. of this 30° Bé. liquor contains 70 grms. sugar; 157 c.c. contains 110 grms. sugar. (C) Into a glass stoppered 100 c.c. graduated cylinder, run 10 c.c. water followed by 1 c.c. each of 5 per cent. tannic acid and 5 per cent. ferric chloride. Mix and immediately dilute to 100 c.c. 100 c.c. of (C) contain 2 c.c. of 5 per cent. of negative colloid; 1·6 c.c. of (C) contain 0·0016 grm. of negative colloid; 1·6 c.c. of (C) in 157 c.c. of (B) or 110 grms. sugar equals $\frac{1}{32}$ lb. per ton sugar or 14 per million or grms. per ton. With tannic acid at 100 cents per lb., ferric chloride 25 cents per lb., and using 1000th lb. colloid per ton, we have 0·125 per cent. per ton to treat the sugar. Six portions of 157 c.c. are treated with 1, 2, 3, 4, 5 and 6 amounts of the colloid, mixed and run into the char tubes. On complete drainage, the tube giving the lightest or white liquor contains the proper amount of colloid per ton to be added. Iron-blue tannin is preferred, but the iron $\frac{1}{2}$ green type, and also other metals, as bismuth, manganese, as well as purely inorganic colloids, etc., may also be used. A colloidal tannate has no chemical or invertive action of the sugar. If the solution to be purified contains either soluble iron or tannin, these should previously be converted first into an active colloidal tannate of iron by adding thereto a soluble tannate or iron salt respectively.

With this process of refining sugar, the present method of defecating with lime and phosphoric acid, which form dark coloured glucosates and result in lowering the purity of the sugar solution, is entirely done away with, simply a treatment with this colloidal tannate of iron or negative colloid (mineral organic salt) and filtration immediately with or without kieselguhr, with subsequent char treatment, being all that is required to produce white liquors. Since some raw sugars are acid and others alkaline in reaction, the colloidal tannate of iron in acid liquors reacts as a negative colloid, while the same colloidal tannate in alkaline liquors reverses its charge and becomes a positive colloid. In this alkaline state the colloidal tannate splits up, the iron forming a basic condition with basic action, and therefore possesses the positive colloidal property. The yellow or other colouring matter being usually in combination with other impurities in solution, such as bacteria, yeast, moulds, albumins, gums, pectin, polyphenols, phenolcarboxylic acids, catechol, oxidases, chlorophyll, wax, fat, essential oils, resins and mineral salts (ash), on precipitation, also carry down these interfering bodies, and this is partly the cause of the resulting pure white liquors above described.

PROCESS FOR REVIVIFICATION OF SPENT EARTH (KIESELGUHR, ETC.). **L. A. Tarbox** (assignor to **Emlenton Refining Company**). 1,613,299. January 4th, 1927. Spent earth is drawn in a stream through a furnace, where its temperature is steadily raised out of contact with the flue gases, air being introduced at various points in the stream in sufficient amount to burn off the carbonaceous matter.—DECOLORIZING AND CLARIFYING AGENT. **Harold S. Christopher** (assignor to the **Standard Oil Co.**, of California). 1,617,476. February 15th, 1927. As a new article of manufacture substantially pure hydrous aluminium silicates having active decolorizing or clarifying properties, comparatively low in aluminium content and corresponding substantially to the empirical formula $Al_2O_3 12(SiO_2).2H_2O$.—FILTER CLOTH. **James E. Hooper** (assignor to **William E. Hooper & Sons, Company,** of Baltimore, Md., U.S.A.). 1,617,597. Feb. 15th, 1927. A filter-cloth for use with a filter-press is described, this latter composed of registering plates and frames having contacting portions near the edges to hold the edges, the filter-cloth having thickened portions registering with the contacting portions of the plates and frames, said thickened portions on two opposite parallel edges of the cloth comprising a portion of the same piece of cloth as that composing the filter but of heavier weave than the rest of the cloth, thereby producing a reinforced edge portion and thickened portions extending along the edges opposite to each other and transverse to the first mentioned edges comprising strips of fabric sewed to the filter-cloth.—MACHINE FOR WASHING SUGAR TRAYS IN REFINING OPERTION. **John J. Armstrong,** of Crockett, Cal., U.S.A. 1,617,833. February 15th, 1927. A washing device of the class described comprises a tank having vertically extending slots throught the opposite ends thereof and in alignment with each other, a plurality of rollers within the tank disposed with their axles in a single horizontal plane, said axles being parallel to each other and to the ends of the tank, said rollers being spaced a lesser distance from each other than the length of a flat tray or plate adapted to rest thereupon and to roll thereover, a complementary set of rollers disposed in a superimposed horizontal plane and adapted to rest upon the upper edges of plates of trays which are being advanced on the lower rollers and co-operating with said lower rollers to maintain the tray in a vertical position as it is being conveyed, and spray members disposed upon opposite sides of the path of travel of the tray adapted to project jets of water against the surface of the tray as the tray advances, and means for simultaneously driving all of the rollers to advance the tray through the slotted opening at one end of the tank, through the tank and out through the slotted opening at the opposite end of the tank.—TRAY-SETTING DEVICE. **John J. Armstrong,** of Crockett, Cal., U.S.A. 1,617,834. February 15th, 1927. In combination with a rotary member formed at intervals throughout its circumference, with means for forming articles and ejecting them therefrom at the lowermost point in their travel, uniformly and continuously moving horizontally disposed conveyors for supporting a tray and for carrying it beneath said rotary member to receive said articles, as said member continuously rotates and positively acting means operating in synchronism with the rotary member whereby the advancing tray will be automatically positioned

on the horizontal travelling conveyors whereby the position of the tray will have a direct relation to the operation of the depositing means.—REMOVAL OF SULPHUR DIOXIDE FROM FOODS. **Ludwig Rosenstein**, of San Francisco, Cal., U.S.A. 1,623,070. April 5th, 1927. Hydrogen peroxide is used, in proportion necessary to effect the decomposition.—LOW HEAT LEVEL EVAPORATOR SYSTEM. **Leslie E. Sebald** (assignor to the **Griscom-Russell Co.**, of New York). 1,623,941. April 5th, 1927. In a combined multi-effect evaporator and boiler feed system, means for joining the drains from all the evaporator coils at substantially the pressure existing in the shell of the last effect evaporator, means for conveying the resulting flash steam from said drains together with vapour from the said evaporator shell to a condenser, said condenser being adapted to receive said joined vapours and transfer heat therefrom to the boiler feed water, means for joining the condensate from said coils with the condensate from said condenser at a pressure lower than that maintained in said condenser, a second condenser operating atsaid lower pressure forreceivingsaid condensate and bringing it into heat exchanging relation with the boiler feed water at said lower pressure, and means for conveying the condensate from said second condenser to the primary boiler feed heater, said boiler feed water passing successively through the primary heater, the second condenser and the first condenser.—OBTAINING A CULTURE MIXTURE FOR FERTILIZER PRODUCTION. **Carl A. Baumgarten-Crusius**, of Dresden, Germany. 1,626,579. April 26th, 1927. A process of obtaining a culture mixture for fertilizer production which comprises subjecting a separate lot of decomposing farm soil, horse manure, forest soil and the like to a temperature of approximately 60° C. for a period of about 20 minutes in order to completely or partially destroy undesired bacteria, thereupon dividing said separate lot into two portions, sterilizing one of said portions, dividing the second of said portions into two separate parts, maintaining one of said parts under anaerobic conditions and the other part under aerobic conditions at a temperature favourable to the development of bacteria, thereupon lixiviating said two parts, adding the resulting liquid to the sterilized portion of said lot, mixing the thus inoculated portions together and adding said mixture to a mixture which contains food for the bacteria, and consists of farm soil, horse manure, beech leaves and peat.—USE FOR MONOSACCHARIDES. **David J. Block**, of Chicago. 1,626,910. May 3rd, 1927. A monosaccharide and a non-injurious acid is used claimed as the essential ingredient of a flour improver.—RECOVERY OF GLYCERIN FROM FERMENTED MOLASSES MASH. (*A*) **Samuel K. Varnes** (assignor to **E. I. du Pont de Nemours & Co.**, of Wilmington, Del., U.S.A.). 1,626,986. May 3rd, 1927. (*B*) **James W. Lawrie** (assignor to **E. I. du Pont de Nemours & Co.**, of Wilmington, Del.). 1,627,040. May 3rd, 1927. (*A*) In the art of producing glycerin by the fermentation of molasses, the steps are claimed of dividing unclarified concentrated slop into minute portions, exploding the so-divided slop into mist in contact with a hot gaseous carrier chemically inert at the temperatures involved while maintaining a temperature to quickly vaporize the glycerin from the slop, and condensing the evolved glycerin vapours. (*B*) In the art of producing glycerin by the fermentation of molasses, the steps are claimed of heating the unclarified concentrated slop, bringing the heated slop into contact with a hot gaseous carrier while under pressure, atomizing the slop under a pressure of at least approximately 30 lbs. per square in. to present an extensive surface to the carrier, maintaining a temperature to quickly vaporize the glycerin from the slop, and condensing the evolved glycerin vapours.—USE FOR MOLASSES. **Robert S. Wright**, of Minot, N. Dak., U.S.A. 1,626,998. May 3rd, 1927. Molasses is one of the constituents of a non-corroding anti-freeze composition, comprizing also in aqueous mixture, calcium chloride, potassium bichromate, mineral oil, and potassium bicarbonate.—BAGASSE BOARDING. **Charles W. Mason**, of Olaa, T.H. 1,627,103. May 3rd, 1927. Claim is made for : (1) The method of making artificial lumber from bagasse, which comprises cooking the bagasse in milk-of-lime, refining the cooked fibre to produce a substantially uniform pulp, adding to the pulp from 100 per cent. to 20 per cent. of raw bagasse, forming the resultant fibrous mixture into sheets, and uniting the sheets in superimposed relation to form boards of desired thickness. (10) A fibre board comprising a body of cooked and refined bagasse fibre mixed with raw bagasse impregnated with a vermin-destroying agent.

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	One Month ending June 30th.		Six Months ending June 30th.	
Unrefined Sugars.	1926. Tons.	1927. Tons.	1926. Tons.	1927. Tons.
Poland	1,636	....	13,015	198
Germany	2,869	....	4,890	680
Netherlands	....	....	....	....
France	....	....	....	....
Czecho-Slovakia	342	....	342	1,224
Java	....	400	....	465
Philippine Islands	....	....	....	....
Cuba	22,179	53,642	126,624	186,745
Dutch Guiana	....	....	....	....
Hayti and San Domingo	19,487	11,612	71,442	74,605
Mexico	....	....	....	....
Peru	6,715	7,683	52,777	79,059
Brazil	....	5,894	95	29,502
Union of South Africa	....	....	16,053	4,263
Mauritius	8,488	22,174	149,546	128,658
Australia	3,604	....	126,648	14,754
Straits Settlements	....	....	....	....
British West Indies, British Guiana & British Honduras	11,354	9,996	58,432	61,955
Other Countries	1,375	3,667	13,061	16,226
Total Raw Sugars	**78,049**	**115,069**	**632,925**	**598,334**
Refined Sugars.				
Poland	2,311	....	8,425	3,512
Germany	563	138	6,941	5,362
Netherlands	15,202	13,156	102,349	109,726
Belgium	1,189	1,087	6,557	3,642
France	....	....	....	....
Czecho-Slovakia	42,202	8,845	168,178	87,225
Java	....	....	....	....
United States of America	1,621	5,825	6,444	29,855
Canada	9,328	3,090	36,279	36,343
Other Countries	33	4,859	7,993	10,544
Total Refined Sugars	**72,448**	**37,001**	**343,166**	**286,208**
Molasses	15,781	8,219	81,487	54,957
Total Imports	**166,278**	**160,289**	**1,057,578**	**939,499**

EXPORTS.

British Refined Sugars.	Tons.	Tons.	Tons.	Tons.
Denmark	158	211	677	637
Netherlands	48	45	209	182
Irish Free State	3,795	4,202	28,284	19,214
Channel Islands	68	67	373	273
Canada	....	....	....	....
Other Countries	1,128	1,370	19,519	10,263
	5,197	5,895	49,062	30,569
Foreign & Colonial Sugars.				
Refined and Candy	155	182	968	963
Unrefined	80	89	782	496
Various Mixed in Bond	....	....	....	....
Molasses	79	22	1,774	172
Total Exports	**5,511**	**6,188**	**52,586**	**32,200**

Weights calculated to the nearest ton.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1927. Tons.		1926. Tons.
Total Receipts, January 1st to June 29th	1,656,217	..	1,959,753
Deliveries „ „	1,618,588	..	1,746,515
Melting by Refiners „ „	1,568,798	..	1,651,000
Exports of Refined „ „	46,000	..	52,000
Importers' Stocks, June 29th	152,491	..	221,894
Total Stocks, June 29th	259,198	..	376,687
	1926.		1925
Total Consumption for twelve months	5,671,335	..	5,510,060

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1925, 1926, AND 1927.

(Tons of 2,240 lbs.)	1925. Tons.		1926. Tons		1927 Tons
Exports	2,602,086	..	2,079,391	..	1,825,699
Stocks	1,290,663	..	1,442,232	..	1,357,045
	3,892,649	..	3,521,623	..	3,182,744
Local Consumption	72,000	..	55,000	..	51,000
Receipts at Ports to May 31st	3,964,749	..	3,576,623	..	3,233,744

Havana, May 31st, 1927. J. GUMA.—L. MEJER

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR SIX MONTHS ENDING JUNE 30TH, 1925, 1926, AND 1927.

IMPORTS.

	1925. Tons.	1926. Tons.	1927. Tons.
Refined . ..	339,679 ..	343,166 ..	286,208
Raw	693,743 ..	632,925 ..	598,334
Molasses .	112,749 ..	81,487 ..	54,957
	1,146,171	1,057,578	939,499

EXPORTS (Foreign).

	1925. Tons.	1926. Tons.	1927. Tons.
Refined	747 ..	968 ..	963
Raw	326 ..	782 ..	496
Molasses	214 ..	1,774 ..	172
	1,287	3,524	1,631

HOME CONSUMPTION.

	1925. Tons.		1926. Tons.		1927. Tons.
Refined	352,239	..	296,020	..	290,585
Refined (in Bond) in the United Kingdom	408,024	..	431,886	..	380,044
Raw	44,524	..	79,543	..	74,419
Total of Sugar	804,787		807,449		745,048
Molasses	3,674	..	2,918	..	2,901
Molasses, manufactured (in Bond) in United Kingdom ..	29,485	..	32,642	..	45,317
	837,946		843,009		793,266

STOCKS IN BOND IN THE CUSTOMS WAREHOUSES OR ENTERED TO BE WAREHOUSED AT JUNE 30TH, 1927.

	1925. Tons.		1926. Tons.		1927. Tons.
Manufactured from Home Grown Beet	—	..	250	..	2,350
Refined in Bond	39,700	..	59,300	..	78,350
Foreign Refined	20,200	..	158,000	..	98,400
„ Unrefined	290,750	..	250,500	..	215,200
	350,650		468,050		394,300

United Kingdom Monthly Sugar Report.

Our last report was dated the 8th June, 1927.

After a still further decline in the old crop positions the market turned, and an upward tendency has prevailed for the last fortnight, although New crop prices still lag behind.

The London Terminal market has been quite active recently, the liquidations of June and July have only been small affairs, and have not affected the market. The principal dealings have been in August, in which month large hedge sales have been made against various kinds of merchandise both here on the spot and to arrive, and in some cases, against sugar not even destined for this country. During the latter part of June, bulls of August were anxious to realise, and prices were driven down below the normal value. However, recently, covering orders have brought the value of " paper " nearer to its proper parity. New crop has not been pressed for sale from the Continent, but there have been many selling orders in this market, chiefly on account of stale bulls. August sold from 15s. 7½d. to 14s. 10½d., the lowest point reached, from this price it has steadily recovered to 16s. October sold from 14s. 9d. to 14s. 3¾d. to 14s. 10½d., whilst December moved from 14s. 8¼d. to 14s. 3d. to 14s. 6¾d. March and May have kept comparatively steady, these months sold from 16s. 5¼d. and 16s. 8¼d., to 16s. 0¾d. and 16s. 3¾d. respectively, recovering later to 16s. 3¾d. and 16s. 6¾d. The latest prices are August 16s. 0¾d., October 14s. 10½d., December 14s. 6¾d., March 16s. 3¾d., May 16s. 6¾d.

The demand for Actual sugar has improved during the last few weeks. The Trade have been caught rather bare of supplies; they had rigidly adhered to their hand to mouth policy so long, that when the market turned they were forced to make daily purchases at advancing prices. Ready Granulated has been very scarce, and with an improved demand from Continental countries, the U.K. has had difficulty in securing supplies, except by paying higher prices. A fair business has been done from 16s. 3d. to 17s., and to-day's value is 17s. 1½d. No fresh sales have been made in American and Canadian Granulated, but second hand parcels have continued to sell from 17s. to 17s. 7½d. c.i.f. White Javas have not been pressed, and very little business has been done to this country, most of the sales have been to Continental ports. The latest price is 15s. 7½d. c.i.f. Owing to the probability of an increase in the Import Duty into Germany, this country has been a large buyer of other foreign sugar, especially Czecho and Dutch Granulated. Spot sugar has been in good request and has advanced from 28s. 3d. to 29s. 6d. duty paid.

Home grown sugar is practically finished, but there are still remnants left for sale.

British refiners made a series of alterations during the period under review. On June 13th they reduced their prices 6d. per cwt., they were advanced 3d. on June 21st, and a further 3d. on the 24th June, on July 1st they were reduced 3d., and put up 3d. again on July 7th, with the exception of Cubes, which were reduced 1s. The latest prices are No. 1 Cubes 33s. 6d., London Granulated 30s. 7½d. duty paid.

Raws have been easier, and business was done at one time as low as 12s. 9d. c.i.f., since then however, a fair business has been done at 13s. to 13s. 3d. for Cubans and San Domingos, both to U.K. refiners and the Continent.

In America a fairly large business has been done in Raws, but the price has declined to 2¾d., at which price there are buyers to-day. The futures market has been somewhat irregular owing to the July liquidation which at the lowest point was quoted at 2·56. On balance, however, New York is about 15 points lower than a month ago for old crop, and three points lower for New crop.

F. O. Licht has again increased his estimate of the European beet acreage by 61,500 hectares. His recent increase is chiefly in Russia. His estimate now stands at 2,481,500 against 2,171,415 hectares in 1926, an increase of 14·28 per cent., or without Russia, an increase of 13·08 per cent.

The Cuban crop is now finished with the final figure of 4,508,000 tons. Stocks at the ports are 1,156,430 against 1,327,592 tons last year, and the receipts to date are 3,394,641 against 3,813,938 tons in 1926. Complaints are being received that the growing crop is suffering from drought, the rainfall this year being still below the normal, and provisional estimates of the next crop are 4,500,000 to 4,750,000 tons, without restriction.

21, Mincing Lane,
London, E.C.3.
11th July, 1927.

Arthur B. Hodge,
Sugar Merchants and Brokers.

THE

INTERNATIONAL SUGAR JOURNAL.

☞ All communications to be addressed to "The International Sugar Journal," 2, St. Dunstan's Hill, London, E.C. 3.

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

No. 344. AUGUST, 1927. VOL. XXIX.

Notes and Comments.

The Sugar Duties in Parliament.

During the final stages of the debate in Parliament on the Finance Bill for 1927 the sugar duties once more came up for discussion and a number of critics made speeches on the sugar situation in this country. Labour members reminded the House that the sugar tax bore heavily on the food bill of the working classes, while one or two Unionists drew renewed attention to the effect of the incidence of the duties on the home refining industry. These speakers urged that sugar refined within the United Kingdom should be classed in part as an Empire product and so allowed a rebate; alternatively, that Empire refined sugar should be placed on an equality with home refined, instead of, as at present, getting the full preference. The precarious condition of the Greenock refineries was referred to in the debate; of the five factories in that town formerly employing four or five thousand people, only two remained, and these were struggling against grave adversity. The member for Greenock, Sir GODFREY COLLINS, who is nothing if not a free trader, said he was unable to support any proposal to give protection to the refining industry; his remedy was to sweep away with one stroke the beet sugar subsidy and place these new industries as he deemed it on the same level as the refining industry.

The Government reply to these suggestions was the matter-of-fact one that they could not afford to make any changes this year; least of all could they afford to drop the sugar duties which brought in nineteen millions in a full year. They admitted that the refiners were in an extremely precarious position, owing to the severe competition with which they were faced; but the particular method proposed to deal with that situation could not be accepted by the Government. One effect of giving an additional preference to sugar refined by home refiners would be to upset the whole basis of Imperial Preference.

The debate left one, however, with the impression that next year the Government would have to make some effort to find a remedy that would save the refiners from their worst competitors, the foreign (Continental) refineries, while at the same time leaving the basis of Imperial Preference unimpaired. An increased Customs duty on non-Empire refined easily suggests itself and would probably result in more raw sugar being imported for our refiners to work up; but in that event it might lead to increased competition

with the home beet sugar factories to the disadvantage of the latter. The whole question is a difficult and thorny one and calls for the careful consideration of the Government between now and the date of the next Budget. But in view of the fact that within two years a general election is due, it seems impossible to divorce the sugar question from the politics that has ever made a shuttlecock of it. The present Government has no mandate to introduce ordinary protective duties, especially on food; the Liberals would sweep away both sugar subsidy and Imperial Preference in the name of free trade; Labour is committed to the beet sugar subsidy but not to Imperial Preference (though some leading Labour men such as Mr. J. H. Thomas are favourable to it), while the "free breakfast table" creed is inimical to the continuation of the duties on sugar. Out of this welter of contending political views, it is difficult to shape a policy of support for the various branches of the sugar industry within the Empire—at home and overseas—that will stand a reasonable chance of being accepted by which ever of the three parties in the State happens to be in power after the next elections.

The Sugar Situation.

The principal point of interest in sugar circles remains the question whether the next Cuban sugar crop will be restricted like its predecessor, or whether the President of Cuba will decide in the end that circumstances have altered sufficiently to allow unrestricted production. We at any rate know that according to a decree signed by him at the beginning of June the next crop is not to be started before January 1st, 1928. But the Cuban growers are opposed to restriction and have made their wishes known to that effect. A more decisive factor is the existence of a drought in Cuba this season which has only partly broken. According to figures of the Sugar Club of Havana, the rainfall of the first six months of the year was only half that of the corresponding period in 1926; and the lack of all rain during several important weeks of the growing period has resulted in a strong probability of the next crop being much below anticipations. If nearer the time of harvest the estimates of probable yield show a marked reduction as compared with last season, it seems not unlikely that there will be no great need to impose any restriction at all and the crop may be reaped in full. In this connexion it may be observed that had the full crop of canes been reaped during the 1927 season, the result might have been 5,250,000 tons instead of the 4,508,000 tons actually achieved under restriction.

On the other hand, it has to be noted that both in the United Kingdom and the United States the consumption for the first six months of 1927 shows a decline as compared with 1926. Over here the figures according to the Board of Trade statistics show a consumption for the six months of 745,048 tons of refined and raw, which compares with 807,449 tons a year previously. In the States, Willett and Gray put the six months' consumption at 2,823,575 tons refined value, as compared with 2,866,265 tons in 1926, a decrease of 42,690 tons or 1·49 per cent. But they incline to the view that as stocks are below normal, the figure for the second six months will be close to if not slightly in excess of last year's figure, so that the 12 months' consumption may be quite up to last year's. It would not, however, show the steady increase that has marked the totals during the last four years.

The British Sugar Beet Society.

The future of the British Sugar Beet Society Limited has been in the balance for some months past. At the annual meeting held last February the question of continuing the Society or not came under consideration.

Since the Society had first come into existence conditions had changed gradually, and some of its functions have been transferred to the aegis of the Farmers' Union, while the various factory Companies have lately formed a Manufacturers' Association. Then the British Empire Producers Organization is creating an Association designed to embrace all interests in the sugar industry both Home and Empire. In view of these facts there seemed no longer adequate justification for appealing further for funds wherewith to run the Society.

After discussion at the General Meeting the matter was referred to the Executive Committee to review the whole position. The latter carried out their task, and found that quite apart from the question as to what work remains for the Society to undertake, the matter resolved itself into one of finance. Hitherto the Society has been financed almost entirely by the two factory groups, who subscribed £1250 out of £1391 in 1926, and the measure of their support would now be greatly reduced. As an assured income of at least £1000 per annum for five years is needed to maintain the Society, and enquiries from the chief subscribers and other likely bodies promised no greater sum than £300 per annum, the Executive Committee were forced to recommend that steps be taken to wind up the Society.

This proposal was placed before a special meeting of the Society held in June, but met with opposition on the part of a number of the members, who thought there was much useful work yet to be done by the Society and considered that it would be a bad thing for the factories, the growers, and the whole industry if the central body came to an end. As a result, the matter was referred back for further consideration.

On June 27th the adjourned General Meeting met again, when it was stated that a reasonable measure of financial support had now been promised; so it was decided to continue the Society on the existing lines.

A Beet Sugar Contract Lawsuit.

Considering the difficulties encountered in starting a beet sugar factory in any new agricultural district, it is surely a matter for congratulation that in only one instance in beet factory promotion in this country has there, so far, been an appeal to the Courts for damages for alleged breach of contract. The inherent dangers are manifest. A factory cannot be started till an assured minimum cultivation of beet is guaranteed; on the other hand farmers cannot be expected to incur the cost of growing even experimental crops of beet unless they have the assurance that some factory or other will at harvest time take over their crop and pay for it. In the case which has just been settled in the Courts an attempt was made to establish a factory in the Hampshire district of the south of England, and the two promoters who were made defendants in the action took the usual course of approaching the farmers in that area to get them to grow the necessary acreage, and undertaking if this was obtained to have a factory erected. A syndicate was in view which was prepared to finance and erect the factory, composed of several engineering firms who would divide the contract between themselves, while the well known refining firm of Tate & Lyle were prepared to join the scheme on the understanding that the sugar turned out by the factory could go to their refinery for the final process. Unfortunately the scheme fell through and was finally dropped in 1926. The failure would appear to have been due to lack of sufficient promises of roots by the farmers, thus preventing the promoters from obtaining Government financial assistance through the Trade Facilities

Act. But for the first season a number of farmers were led to grow a trial acreage on the understanding that the crop could be sent to another factory for working up, pending the erection of the local factory. In the case of the plaintiffs to the action at law, they were apparently given to understand that their roots could go to the Bury St. Edmunds factory for slicing, but, as ill-luck would have it, that factory owing to a machinery breakdown was not working when the crop of the plaintiffs was reaped, and the latter finally had to offer their roots to the Anglo-Scottish Corporation, who took about half the crop off their hands. The other half was a loss to the plaintiffs and for this loss they sued the promoters in the Courts. The latter pleaded that they were at most only acting as agents for third parties, viz., the firms who were to make up the syndicate. The court decided that there was a contract to take over the roots if grown, and gave a verdict in favour of the plaintiffs against the two defendants. On the other hand, the latter were unable to establish their claim to have acted as agents, in respect to three of the third parties; but as regards Messrs. Tate & Lyle whose position was not quite that of the other third parties, an agreement was come to out of court, the terms of which were not published. The judge said he thought the parties had acted very sensibly in adjusting a difficult matter; the truth was that the scheme was a very promising one and the whole difficulty arose because the scheme broke down. Nobody had acted dishonourably, and no imputation could rest against anybody of any unfair dealing.

The Natal Sugar Experimental Station.

Although the Sugar Experimental Station at Mount Edgecombe, Natal, has been functioning for the best part of a year, it was only officially opened on May 18th last, Mr. William Campbell, Managing Director of Natal Estates Ltd., performing the ceremony before a representative gathering.[1]

The South African Government has, it is true, generously loaned £10,000 free of interest for a period of five years, but nevertheless this is not a Government station, being maintained by the planters and millers by means of a levy of approximately a farthing per ton of cane. This realization of the planters' needs has been rendered possible in part by the generosity of the Natal Estates, who have provided some 64 acres of land on which the Station has been grouped. The latter already boasts of an up-to-date laboratory, with an excellent staff of chemists presided over by Mr. H. H. Dodds, and fulfils a want which, in view of the magnitude of the sugar industry, should in the opinion of many have been provided by the State many years ago. This magnitude in fact ranks the sugar industry as the third largest in the Union of South Africa, being only exceeded by wool and maize. The premier task of the new station will undoubtedly be to introduce new varieties of cane, so as to relieve the planters from their present sole dependence on the Uba cane. Manurial experiments will however also be extensively undertaken; and Mr. Campbell expressed the hope that the station might have experts capable of making bacteriological tests, on which he personally laid more stress than on chemical ones as far as results went.

British West Indian Notes.

The *Monthly Review* of Barclay's Bank for June last in a quarterly report from the British West Indies had the following notes on the sugar industry in those colonies. In Barbados trade is improving and the greater

[1] This account is gleaned from various notes appearing in the *African Sugar and Cotton Planter*.

part of the sugar crop has been sold at prices which, on the whole, show a satisfactory average. In Trinidad unusual weather has interfered with the grinding of the sugar crop, owing to frequent and heavy showers occurring in the " dry season," and the quality of the juice has been thereby affected. That and the froghopper pest have led to a much smaller crop being reaped. But next year's canes have benefited from the abnormal rains and look very promising. The trading position in Jamaica is improving and there is a feeling of quiet optimism. The sugar crop is estimated at 65,000 tons and with a satisfactory average price this should enable planters to make fair returns. The market for rum remains very quiet. British Guiana is only now recovering from the disastrous drought of 1926 which seriously affected exports of sugar. But given normal weather conditions in the present year—and up to the present they have been good—exports should be restored to something like their old level. Sugar exports were in 1926 85,000 tons, compared with 98,000 tons in the preceding year. In the Leeward Islands weather conditions havec ontinued exceptionally favourable and it is estimated that the Antigua sugar crop now being harvested will reach 20,000 tons ; at the same time, good rains have well established the plant canes for the next crop. Similar remarks apply to St. Kitts, where a record sugar crop is expected.

Beet Sugar in Southern Alberta.

The sugar beet industry, in so far as production is concerned, is in its infancy in Canada. Of the 415,000 tons of sugar consumed in that country in 1924, only 10 per cent. was Canadian beet sugar.

Although beet growing was introduced in Alberta in 1903, first operations did not prove altogether successful owing to competition in the sugar market and the inability to secure sufficient acreage tributary to the factory. It was not until 1924 that the erection of a modern refining plant in the heart of the irrigated areas of southern Alberta again revived the young industry. This factory, with a grinding capacity of 1000 tons of beets per day, can utilize the crop from about 11,000 acres.

In 1925 some 5400 acres were seeded to beets, producing 41,500 tons, from which 3500 tons of sugar were manufactured. The following year, while the acreage and tonnage were slightly less the sugar content of the beets was higher and 4800 tons of sugar was produced. The price paid the grower in 1925 was \$5·75 per ton ; in 1926, \$6·25 per ton ; and for the coming season \$7 per ton has been guaranteed. This steady increase in price, which is most encouraging to the growers, is attributable in a large degree to the consistent increase in the sugar content of the beets grown, but is partly due to the general advance in the price of sugar. The sugar content of the 1926 crop reached the satisfactory average of 16·43 per cent.

From data collected during the short period of operation in Alberta it is estimated that the cost of producing an acre of beets is approximately \$60. An average yield of sugar beets is about 10 tons per acre, but with proper cultivation, a fertile soil and efficient irrigation this can be considerably exceeded, more than 20 tons per acre having been grown under favourable conditions.

The beet is a heavy soil feeder. A 5-ton crop removes from the soil more mineral plant food than a 60-bushel crop of corn, a 50-bushel crop of wheat or a 300-bushel crop of potatoes. It is, therefore, essential that such crop rotation and cultural methods be adopted as will maintain an adequate food supply. At the same time this crop requires a moist soil at all times, but

particularly during July and August when the plants' requirements are greatest. From 18 to 20 in. of water during the growing season is required to produce the highest yields, and such an amount in southern Alberta can usually be obtained only when the natural precipitation is augmented by judicious irrigation.

The Anglo-Ceylon Co.'s Sugar Year.

The report of the Anglo-Ceylon & General Estates Ltd., for the year ending March 1926, shows that a net trading profit of £120,871 was made (which compares with £110,107 for 1925-26); but the income was all due to the tea and rubber crops in Ceylon, the sugar crop in Mauritius resulting once more in a loss; this time, however, the deficit was only £2000, which compares with one of £18,000 a year previously. Including bought canes, 149,803 tons of cane were handled on the Mauritius estates, producing a crop of 15,321 tons of sugar, as against 14,777 tons in 1925-26 from 144,328 tons of cane. The hurricane of May 18th, 1926, largely affected both the yield of canes and their richness, so that in spite of thelarger acreage under cultivation the returns for last crop were only slightly more than in the previous season. Prices for sugar, though about £2 per ton better than in 1925-26, continued at a low level.

At the annual meeting the Chairman (Sir Edward Rosling) said that the outlook for sugar in the current year was rather more promising in spite of continuing low prices, and the directors had every hope of seeing a profit this year, though not a large one. Sugar had its ups and downs, but taking the average returns from their Mauritius interests for the last ten years they had found the property a distinctly satisfactory investment. This year except for two small hurricanes, in January and in March, which did but little damage, the weather had been favourable so far, and a total output from the three factories of 16,500 tons is hoped for.

The Peterborough Factory in its First Year.

In our list of home beet factory results which we published in the July issue we were unable to include particulars of the result of the first year's working of the Dyer-designed factory at Peterborough belonging to the Central Sugar Company, Ltd. The following data respecting this promising new factory are needed to complete the record.

This factory has an issued ordinary capital of £175,000, plus £185,000 of 5 per cent. guaranteed debenture stock. The land and factory equipment and buildings are valued at £284,310. The trading profit for the year ended March last amounted to £132,747, and interest received and other items brought it up to £136,748. Expenses of management, including directors' fees, amount to £19,513; interest on debentures £10,558; depreciation allowed is £23,450; provision for income tax £20,534; preliminary expenses written off £17,273. A net balance on profit and loss account of £45,420 results, out of which the directors are paying 10 per cent. dividend and carrying forward £31,420. This, it will be admitted, is a very satisfactory result for a first year, and speaks well of the arrangements of the factory and of the care with which the opening campaign was planned. Unfortunately the Directors' report does not give us any information as to the field operations, nor to the growers' share of the favourable results.

British Beet Sugar Notes.

The Anglo-Dutch group of beet sugar factories announce that they have secured a site for a sugar factory two miles from Bridgwater, Somerset, and will erect thereon a beet factory in time for the 1928 crop, providing the farmers within the factory radius undertake to cultivate the necessary acreage of roots. This site adjoins the Great Western Railway and also a canal belonging to the railway company, so that a water supply is assured and easy transit for roots and finished sugar is available.

The North Yorkshire and South Durham farmers are planning to support a factory to be erected in the Darlington district. A leading firm of manufacturers are reported to be interested in the venture; but the preliminary stage of securing the necessary acreage of 12,000 acres has yet to be completed.

In Ireland the success of the Carlow sugar factory has led to attempts to start others in one or two fresh districts. Carlow serves the countries south of Dublin, and it is now proposed to centre one or more factories in the counties to the north-west of the capital. A claim is also put in for one in Cork county. Carlow factory in the 1926-27 season manufactured 11,979 tons of sugar, and its proprietors, the Irish Sugar Manufacturing Company, received by way of subsidy £181,502, according to a statement made in the Dail.

In Parliament recently the Minister of Agriculture issued some figures showing the amount of subsidy paid to the various beet sugar factories in Great Britain since the introduction of the subsidy.

Factory.	1924-5.	1925-6.	1926-7.
Cantley	£272,517	£331,934	£460,984
Kelham	119,188	86,224	242,679
Ely	—	187,599	466,831
Ipswich	—	57,034	401,259
Colwick	74,092	150,022	258,278
Spalding	—	—	124,197
Kidderminster	—	63,163	149,373
Poppleton	—	—	141,673
Felstead	—	—	85,984
Wissington	—	48,725	92,242
Bury St. Edmunds	—	73,603	346,441
Peterborough	—	—	164,612
Greenock	—	2,759	14,784
Cupar	—	—	49,195
Total	£465,797	£1,001,065	£2,998,542

Another statement issued shows the amount of the individual guarantees made under the Trade Facilities Act to the various beet sugar factories that have applied for assistance.

Name of Company.	Factories.	Guarantees given.
Anglo-Scottish Beet Sugar Corporation	Colwick Spalding	£610,000
Second Anglo-Scottish Beet Sugar Corporation	Poppleton (York) Cupar Felstead	865,000
West Midland Sugar Co.	Kidderminster	150,000
Orchard Sugar Co.	Greenock	180,000
Central Sugar Co.	Peterborough	185,000
Lincolnshire Beet Sugar Co.	Bardney	225,000
	Total	£2,215,000

Sugar Beet and the Cost of its Production.

Some Comparative Figures.

In the Monthly Bulletin of Agricultural Statistics,[1] issued by the Canada Dominion Bureau of Statistics there recently appeared a paper comparing the cost of growing sugar beets in England, the United States, and Canada. From this we reproduce the following tables and notes.

ENGLAND.

The cost of producing sugar beet in England was investigated in 1924, and a report on the subject by A. BRIDGES and R. N. DIXEY of the Agricultural Economics Research Institute, Oxford, was published as "Research Monograph No. 3," by the Ministry of Agriculture.[2] The report itself should be studied by those wishing to go thoroughly into the costs of growing beet, but for present purposes it will suffice to give the detailed costs for the general average of 34 farms investigated, as taken from Table 4 in Appendix II of the Report. They are shown in Table I, the Canadian equivalents of the English currency being added at the par rate of conversion.

I.—AVERAGE COST OF AND RETURNS PER ACRE FROM THE GROWTH OF SUGAR BEET IN ENGLAND, 1924.

Items	English currency £	s.	d.	Canadian currency $	cts.
Labour	11	9	10	55	93
Farmyard manures	2	4	3	10	77
Artificial manure and residues	3	8	10½	16	76
Seed	0	8	2	1	99
Rent and rates	2	0	6	9	85
Other expenses	2	0	8	9	90
Total cost	21	12	3½	105	20
Transportation	2	10	8	12	33
	24	2	11½	117	53
Gross price received	25	18	3	126	11
Profit	1	15	3½	8	58
Manurial residues	1	16	5	8	86

The average yield of washed roots was 10·20 tons per acre. "Tare," i.e., the amount of dirt adherent to the roots carried to the factory, ranged from 8·7 to 45·5 per cent., and the average was 15·9 per cent. The sugar content ranged from 14·2 to 19 per cent., and the average was 16·6 per cent., which was well above the standard set by the factories, viz., 15·5 per cent. The average approximate distance from the factory of the railway station nearest to the farm was 28 miles.

Table I shows therefore that for the 34 farms investigated, the average total cost of production and transportation in 1924 amounted to $117·53, the average gross price received was $126·11, leaving an average profit per acre of $8·58 in addition to the value of the manurial residues after lifting of the crop, estimated at $8·86. Reduced to a tonnage basis, the report shows a total average cost of $11·51, and a gross price of $12·35, showing the profit per long ton of 84 cents in addition to 87 cents, the estimated value per ton of the manurial residues.

[1] Vol. 20, No. 223 (March 1927) pp. 90-94.

[2] Sugar Beet: The Results of an Inquiry into Costs of Production, Yields and Returns in 1924. Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1. Price 3s., post free.

Sugar Beet and the Cost of its Production.

UNITED STATES.

In the issue of the Monthly Bulletin for December, 1925 (p. 390), brief reference was made to an inquiry conducted by the United States Tariff Commission into the cost of sugar beet production in the nine States of Michigan, Ohio, Nebraska, Colorado, Utah, Idaho, Wyoming, Montana and California. The results are in process of publication in the form of a report of ten parts, nine dealing with the different States represented, and the tenth summarizing the costs of production of sugar beets in the United States and presenting an economic analysis of the sugar beet industry. Up to the present seven parts have been published, dealing with the States of Michigan, Ohio, Nebraska, Colorado, Utah, Idaho and Wyoming. Each part gives the costs for the States, as compared with the United States as a whole.

II.—AVERAGE COSTS PER ACRE OF THE PRODUCTION OF SUGAR BEETS IN THE UNITED STATES, 1921-23, AND FOR THE AVERAGE OF THE THREE YEARS 1921-23.[1]

Items	Three year average 1921-23 $	cts.
Machine operations, etc.	17	37
Contract labour	23	02
Horse labour	12	58
Tractor and labour of operation	1	43
Seed	3	39
Commercial fertilizer	0	51
Manure	3	94
Minor direct costs	1	11
Equipment, repairs, depreciation and shelter	4	46
Irrigation	1	69
Taxes	3	14
Minor general costs	1	12
Gross costs, excluding capital charges	73	76
Credits	2	97
Net costs, excluding capital charges	70	79
Capital charges—		
Land charge	13	43
Interest at 6 per cent. on other capital	1	76
Net costs, including capital charges	85	98
Average returns to growers	87	88
Profit, excluding capital charges	17	09
Profit, including capital charges	1	90

CANADA.

There are at present for Canada no data respecting the costs of growing sugar beet derived from specific statistical inquiries as in the case of England and the United States, but Dr. FRANK T. SHUTT, Dominion Chemist at the Central Experimental Farm, Ottawa, has furnished a statement of the costs of growing sugar beet in Ontario, as recently supplied to him by Mr. HENRY STOKES, Agriculturist of the Dominion Sugar Beet Co., Ltd., of Chatham, Ontario. The Dominion Sugar Co., Ltd., are themselves growers of sugar beet, besides contracting for the supply of sugar beets from growers within the radii of their two factories. The total cost in this instance works out at $46·75 per acre.

Mr. E. S. HOPKINS, of the Central Experimental Farm, has furnished the following statement (Table III) as to the estimated cost of growing sugar

[1] This table is given here in abridged form. In the *Monthly Bulletin* the figures of the three years, 1921, 1922 and 1923, are also shown.—ED. *I.S.J.*

beets in Ontario and Alberta. This is based, he states, upon the cost of growing a somewhat similar type of crop such as mangolds.

III.—ESTIMATED AVERAGE COSTS PER ACRE OF GROWING SUGAR BEETS IN ONTARIO AND IN ALBERTA.

Items	Ontario Statement	Ontario Amount $ cts.	Alberta Statement	Alberta Amount $ cts.
Rent and taxes	Including overhead expenses	7 50	Including irrigation charge	8 00
Manure	40 per cent. of 16 tons at $2	12 80	No charge is made for manure	
Seed	6 lb. at 70 cents	4 20	6 lb. at 70 cents	4 20
Machinery		2 85		1 35
Manual labour	135 hours at 25 cents	33 75	135 hours at ' 30 cents	40 50
Horse labour	80 hours at 10 cents	8 00	80 hours at 8 cents	6 40
Total		69 10		60 45
Yield per acre[1]	9 tons		10 tons[2]	
Cost per ton	$7·68		$6·04	
Value per ton	$10 (9 tons at $10)	90 00	$10 (10 tons at $10)	100 00
Profit shown		20 90		39 55

It will be observed that whilst the Dominion Sugar Company places the cost at $46·75, the total given by Mr. HOPKINS is $69·10. In the former case, however, the expenses would be less upon land adjacent to the factory and cultivated in close connexion with it. The costs as estimated by Mr. HOPKINS are doubtless nearer to those received by the average farmer growing beets under contract for the factory.

Upon comparing the costs of the production of sugar as between the three countries, England, the United States, and Canada, the cost is shown to be highest in England, where in 1924 the total average cost for all farms is $117·53. In the United States the total for 1923 amounts to $78·20 (including capital charges), and the Canadian total, as estimated by Mr. HOPKINS, is $69·10 for Ontario and $60·45 for irrigated land in Alberta. The figures are not exactly comparable owing to differences of year and methods of computation; but they appear to indicate that the advantage lies with Canada in respect of the costs of cultivation. Profits depend upon price, season and yield; but it will be noticed that in all three countries the profits to the growers are substantial, being $8·58 per acre in England (1924); $22·71 in the United States (1923); $20·90 in Ontario and $39·55 in Alberta, the Canadian figures being based on average yields and values.

An important element in the condition affecting the growth of sugar beet is the value of the manurial residues. To these the English investigators assign the definite sum of $8·86 per acre. In the United States inquiry the value is taken into account by charging to the first crop 50, to the second crop 30, and to the third crop 20 per cent. of the farmers' estimate of the farm value of the manure, excluding the cost of haulage and application.[3] The point is

[1] Average yield for 5 years, 1920-24, in Ontario given in the Canada Year Book, 1925, page 256

[2] Average yield—1923 to 1925—at Lethbridge Station on irrigated land (see Report of this Station for 1925, page 26).

[3] Report on Costs of Producing Sugar Beets, Pt. I. Michigan, p. 11, U.S. Tariff Commission, Washington, U.S.A., 1925.

referred to in the statement furnished by Mr. STOKES for Ontario; and in Mr. HOPKINS' estimate, the charge for manure is placed at 40 per cent. of the value for Ontario, whilst no charge is made for manure in the cost of Alberta, presumably owing to the high natural fertility of the irrigated land.

It is certain that wherever the climatic, cultural and economic conditions are favourable for the establishment of beet sugar factories, the sugar beet is a profitable agricultural crop, besides giving rise to increased employment on the land and entailing an excellent preparation resulting in increased yields for succeeding crops in the rotation. Futhermore, it is worthy of note that Canadian-grown sugar beet seed has given results fully equal to those obtained from the best imported seed, as has been proved by experiments conducted continuously upon the Dominion Experimental Farms since 1902. In 1926 the averages from sugar beet grown at 21 of the Branch Farms and Stations throughout the Dominion were: Sugar in juice 17·5; co-efficient of purity 86 per cent.

Sugar Production in British Tropical America.

A Survey and Some Recommendations.

In the June issue of *Empire Production* appears a long paper by Mr. HAROLD T. POOLEY, Director of the British Empire Producers Organization, giving an account of his recent visit to British Guiana and the West Indies, in the course of which he investigated the politico-economic position of those colonies. We give below some excerpts that relate to the sugar industry.

ECONOMIC CONSIDERATIONS.

Aspirations towards the political federation of the West Indian Colonies and British Guiana have been due largely to the desire to establish the control over their own destinies which the Dominions enjoy. This question of political federation is sufficiently remote, and if it is to pre-suppose anything like complete " democratic " control in each of the constituent Colonies, then it is outside the range of visible probability. The West Indian Conference, which the Colonies owe to the foresight of Sir EDWARD DAVSON, provides precisely the machinery which is adequate to present-day conditions. Its first report strengthens the view that economic federation, or, at any rate, close economic agreement, is much more a matter of practical possibility. There seems, however, little doubt that even that will have to come by stages, the first of which must be agreement in regard to certain individual industries.

A mutual interest in sugar, amounting in some cases to a dependence on that product, has been the basis of most of the common action on the part of these Colonies in the past, and will always continue to be a most important tie. If the sugar planters had had the preference from Great Britain that common justice demanded in the openings of the bounty-fed European beet industry, the West Indies would be flourishing, British Guiana might have held the position that Cuba holds to-day, and Great Britain would be many millions richer. It is not even yet too late for much to be done, and the free import of their sugar into Britain, retaining the duty on foreign sugar at its present level, would stimulate West Indian prosperity more than any other single action, and would react in purchases from Britain that would outweigh any sacrifice of revenue. . . . . .

In purely economic conditions our West Indian Colonies vary markedly. Barbados, small, self-contained, cultivated to the very rim, and with a teeming black population ; British Guiana, below the sea level, under-populated and lacking labour, its large planters being for the most part still larger merchants, off the beaten track of trade, with a hinterland of untold possibilities like some Sleeping Beauty awaiting an awakening force ; Trinidad, rich in its oil wells and asphalt, once the only and still an important entrepôt for Venezuela, the Spanish Main, and the Eastern Antilles, finding in its wealthy merchants a new and valuable class of agricultural producer, possessing perhaps the most effective example of real co-operation in the whole area, steadily engaged on centralizing its important sugar production.

Jamaica, in the wash of the traffic to and from North America and the Panama Canal, emphasizing the distillation side of its sugar industry and suffering for that because of prohibition on one side of the Atlantic and extravagantly high duties on the other, divided in its affections between the old love Sugar and the new love Fruit, striving to make a policy for the independent handling of the latter, preoccupied with a demand for direct transport apart from the lines controlled by those who control the market for fruit, capable of developing an enormous tourist business, tending a little perhaps to regard itself as apart from the other West Indian Islands. . . . .

There is no industry in the world which more urgently demands co-operation and good accounting than agriculture, and there is probably no industry which gets less. If this is true of all agriculture it is most emphatically true of that which is carried on in the Tropics. Nature in those parts is lavish both in generation and destruction. The average of a well-conducted cane sugar estate, for example, may easily be a substantial average profit over a period of fifty years ; but if the annual results are plotted the line will go to the top of the chart in one year and perhaps to the bottom of it the next. For this reason, the industry must be on a wide basis and must freely share its discoveries : that is co-operation. Further, it must be prepared to regard its peak years with pessimism in order that it may be able to face its years of disaster with fortitude : that is accounting, and particularly cost accounting. Cost accounting reveals not merely what each acre gives of sugar, or any other product, but the even more vital knowledge how many dollars of profit that acre yields. In addition, it points to those parts of an industry that are not pulling all their weight, and in cane sugar it points infallibly to the need for cane yielding a higher sugar content. The factories can extract a maximum of the juice that is in the cane, and with little additional cost they could extract more if it were there, so that the immediate need is for cane with more sugar in it and for research to produce that cane, dealing of course with the underlying problems of soil, tillage, drainage, irrigation and so forth. So again the argument swings full circle to co-operation : in order to urge upon the Governments the rights of producers in the chief market of the Empire ; in order to bring about the best method of economic organization with its focal point of sound accounting ; and in order to concentrate in a common effort on the research, particularly field research, the need for which accounting reveals.

Tropical agriculture suffers, too, from the conflict between two extremes : the settled ideas but incalculably valuable experience of the man who has been for many years in one Colony or even on one estate; and the concentrated but untried theory (combined with a not-to-be-despised energy and enthusiasm) of the youth fresh from scientific training. And the business of co-operation is to leaven the fine mass of the one with the multiplying yeast of the other—allowing the gaseous by-products to escape.

British Guiana.

The sugar industry (including rum), the most important in British Guiana, is mainly conducted by large firms who are also merchants. The control of these firms is not, as a general rule, in the colony, and in only a few cases do the proprietors visit British Guiana with any regularity. There are, in addition, a few individual estates, some of which are grouped together. Owing largely to the low price of sugar and the lack of sufficient labour, a tendency to centralization and improvement of production has grown in the colony. This has resulted in considerable attention being paid to factory methods. (It may be mentioned here that in one factory, as one example of many, I was told that continual and continuous efforts to get British machinery were defeated by strikes in Britain until, no longer delay being possible, orders had to be given to the United States). As in all the colonies, factory work is further advanced than field work, but a realization of this is causing new effort on the part of the British Guiana Sugar Planters' Association, in which the industry is organized. A sugar experiment station, supported by the Association, is examining soil problems and investigating new varieties of cane. The Superintendent of the station claims that the correction of the view that Demerara subsoils were generally alkaline, by station experiments establishing a slight acid reaction, is of the highest importance. Attention is also being paid to the mechanical condition of the soil, a subject of much importance in view of the wet stiff soil in which most of the cane is grown. Planters are anxious for the new and suitable varieties of cane with a higher sucrose content upon the production of which so much depends, and the station, fully realizing the urgent importance of such new varieties, holds that soil conditions must be made right for them. Field records are carefully kept, and enable the history of any variety, wherever planted, to be followed, or, by a cross classification, the behaviour of any field to be estimated, under differing treatment. Success should certainly attend the station's work, if, on the one hand, the industry takes a broad view of the time and work necessary to produce results from research and experiment, and, on the other, the station avails itself of the incomparable practical knowledge of the planters with long and successful experience of cane planting and sugar production in the colony. The planters bear practically the whole burden of the station, and it seems a clear case for support from the Empire Marketing Board's Research Funds.

Among the planters themselves there might be more co-operation of a technical kind. I found no reluctance on the part of any planter to explain all his methods freely to others in the industry, but there may perhaps be a little lack of enthusiasm for the part of an explainee. Personal discussions, of varying practices, would be of the utmost value. Various factory refinements and a mass of drainage, mechanical cultivation, and fertilizer problems are being examined individually. There does not appear to be enough personal discussion of these ; each man rather backing his fancy.

The Sugar Planters' Association is doing good work. The collection of statistics and circulation of comparative results of the various estates is of high value, the sugar experiment station has already been referred to, and papers and discussions bring those interested in the industry together upon matters of common interest. On the political side, the arguments for an increased and established preference have been ably marshalled and presented on many occasions. The objects of the Sugar Federation of the British Empire were generally approved.

Demerara has two especial sugar cultivation features. Canes ripening all the year round—at one estate I saw fields in every stage from fallow to fallow—and the system of empoldering lands and its concomitant of water transport. Labour, as is well known, is short, which in addition to the severe limitation of cultivated acreage in the midst of potential square miles, has led to some inevitable bad practices, such as burning trash on cane, but also to much ingenuity in labour saving. Here, as was also the case in the West Indian Islands I visited, the factories are generally working with much less cane than they can handle.

The British Guiana Sugar Planters' Association have established their case that a fair offer was formerly made to East Indian labour, but a deadlock persists on the present suggested terms, which, I was informed, the colony cannot possible implement. There does not seem sufficient warrant for the view held by some persons that considerable supplies of negro labour would be available for British Guiana from the British West Indian Islands. A certain number might possibly be obtained from Barbados, but Jamaica, so often quoted as a source, owing to the migration to Cuba, is likely to need all her labour, if she develops as her potential wealth justifies one in believing she will. The East Indian is happy and successful in British Guiana, and no effort should be spared to persuade the Government of India, for the sake of their own people to accept terms less one-sided than their stipulations of 1925.

I was very deeply impressed—an impression that was strengthened at every stage of my visit to the colonies in this area—with the importance of thorough accounting methods, and more especially of cost accounting. Accounts provide diagnosis, and without accurate diagnosis there cannot be successful treatment. Tropical agriculture requires the most careful and systematic cost accounts for the especial reason that its financial results vary so largely from season to season ; but it appears to be the exception rather than the rule that anything like accounting on this scale exists. Some few estates are developing excellent systems with complete field records, and the benefit is apparent.

Considerable doubt as to the effect of the competition of Dominion producers in the sugar market of Britain is expressed, but producers realise the necessity of acting as a whole-Empire industry. They seek, however, and somewhat naturally, some assurance that when the Empire supply begins to form a large proportion of Britain's sugar consumption, the Colonial producer will not suffer from competition from highly protected Dominion suppliers enjoying an equal measure with the Colonies of preference in Great Britain. Producers are sympathetic with the refiners of Great Britain, and anxious to co-operate in every way, though they do not feel justified in making undue sacrifices of the possible future development of white factory sugars, without very substantial assurances of a buying preference at the hands of British refiners for their raw sugars. The free entry of their sugars into Great Britain with the maintenance of the present duty on foreign would, without question, be the salvation of the West Indies and British Guiana. That every effort must be directed to achieving this seems to be the conviction of all those engaged in the industry in the colonies visited.

Considerable importance is attached to the production of power alcohol from molasses, and one estate runs its field machinery and motor vehicles on the spirit so produced. Nearly all the factories produce bagasse in excess of their fuel needs, and there is considerable enquiry in regard to the processes for compression into board. Molasses is also being bought very generally by a U.S.A. Molasses Corporation.

To those who are apt to bemoan the supposed lack of efficiency in West Indian sugar production, a salutary lesson and a cure for their pessimism might be found in the three British Guiana sugar estates I was able to inspect—the Blairmont group, Diamond, and Uitvlugt—and doubtless in many others I did not see.

TRINIDAD.

A large number of small estates in the southern part of Trinidad have been amalgamated to form a group, of which the central is the Usine Ste. Madeleine, and an attempt is being made to group others further north into a second amalgamation. The mills at the Ste. Madeleine are British, and one set of rollers is 47 years old, and still operating. Labour-saving devices and mechanical refinements are up-to-date. The out-turn capacity is normally 25,000 tons of sugar, but last year's output was 29,365 tons. There is a refining plant. including the Bach sulphitation and Suchar processes, neither of which is in operation. Yellow crystals were being made. Field methods appear to be of a very high order. Sunhemp was being grown between the rows for green manure, and Bengal bean as a rotation crop. The Ste. Madeleine estates have inaugurated systematic cost accounting. The variety of processes involved in sugar production, agricultural, chemical, mechanical, etc., make it essential that these should be thoroughly co-ordinated ; and good accounting is the basis of such co-ordination. The manager is an experienced accountant, and has introduced a system which gives a true picture and history of every point of every process in field or factory.

The whole sugar area hás suffered badly from the froghopper pest, and the factory is consequently not working to capacity. This is in the northern sugar area, and an effort is being made to amalgamate the estates in that area on the lines of the southern group.

A very much larger proportion of cane appears to come to the factories from small farmers in Trinidad than is the case in British Guiana or Jamaica. The roads are filled with a stream of small carts conveying cane in this way.

The froghopper pest is one of the most serious obstacles to cane growing ; for example, in 1916-17 the sugar exported was 71,000 tons ; in 1917-18, 45,000 tons ; and 50 per cent. of this loss was officially attributed to the froghopper (Report on Froghopper Blight, by C. B. Williams, January, 1921). A committee representative of the leading sugar companies, the interested Associations and the Imperial College, under the chairmanship of the Director of Agriculture, the Hon. W. G. FREEMAN, is engaged upon an examination of this important subject. Among the problems being studied are the following : Preventive measures ; including clean cultivation, selection of varieties and rotation crops, such as the Bengal bean, which deprives the froghopper of its natural food (grasses). This is much favoured, and interplanting of sunhemp and rotation with Bengal bean may have helped to cause the comparative freedom of Ste. Madeleine. Destruction by spraying, etc. ; cyanogas insecticidal dust has been tried with promising results ; a large effort with this preparation is being made this year.

Natural enemies : As far as I know, the introduction of bird sanctuaries is the chief or only measure taken on these lines. It is said that the mongoose destroys the natural enemies of the froghopper, and an old bounty of 6d. per mongoose body is to be renewed.

In Trinidad, as in British Guiana, there is a surplus of bagasse over fuel needs. Ste. Madeleine exports bagasse to a Celotex Company. There seems a *prima facie* case for a central bagasse-board factory in Trinidad for

that colony and also one for British Guiana, but the tendency of successful field research is to produce less fibre, and it may be a narrow economic margin between burning bagasse on the one hand and selling bagasse and burning oil on the other, even in Trinidad where oil is easily available.

JAMAICA.

The production of sugar, as such, in Jamaica has undoubtedly suffered from the fact that rum has until recent years been in many ways a more profitable product, but there are signs now that more modern equipment and more scientific field methods are gaining rapidly upon the industry. A great deal of what was sugar land has been devoted to banana growing, not always wisely, but much excellent flat land remaining has all the requirements for sugar production save one, and could be, and in some cases is being, rendered completely suitable by the application of irrigation.

Amity Hall, in Vere, has obtained the best results in the island and especial attention has been paid there to careful cost accounting and to field work, especially the development of new varieties of cane. There is a well-equipped and stocked nursery of young canes on a scale very much greater than that of any other sugar estate visited. The irrigation scheme for the Vere district is now an accomplished fact. This is flat country in the south of the island and at the foot of a range of limestone hills into which the streams disappear, the only available water being from Salt River, which, as its name implies, is not suitable for direct irrigation. Accordingly water has to be brought from the Cockpit river or lagoons for a distance of about six or seven miles by a level canal, whence it is pumped seventy feet up to a high level supply, whence the flat district of Vere is irrigated. This is a co-operative scheme which has proved of considerable value to the district.

Gray's Inn Factory, near Anotto Bay, was apparently put down by its former owner in an area devoted to bananas in the hope that sugar cultivation would follow it, a hope which has not been realized, although owing to an understanding with the Atlantic Fruit Company (aided by Panama disease in banana walks in the district) it is possible that greater supplies will be forthcoming in future years. This factory is on the "T" shape system, the boiling house going out at right angles from the centre of the mill. It is electrically driven and well equipped and designed. The shortage of cane has, I understand, prevented the factory from operating on a profitable basis.

Catherine Hall, near Montego Bay, is a good example of a small factory economically run, and the Barnett estates which supply it with cane have excellent cultivation and a partial irrigation system.

Duckenfield, on Plantain Garden River, is a well-built modern factory electrically driven. The Managing Director is a Cost Accountant and has established the factory and field accounts on an excellent basis. I had the advantage of going through the system with him. The factory has a capacity of 10,000 tons of sugar, and the Company have about 7000 acres of land all of which is alluvial and flooded periodically by the Plantain Garden River. Cultivation is simple and the yield should be good. There is, however, in this Eastern part of the Island the recurrent risk of hurricane. A light railway held jointly with the United Fruit Co. goes through the property and also connects it with Morant Bay, a deep water port.

The Rum industry of the Colony has suffered owing to the high duties in Great Britain and prohibition in the United States, but there would appear to be scope for considerable development if unity can be achieved

among the producers for the purpose of publicity on this side. I inspected distilleries at the four sugar factories named above, as well as in one or two other places. The method generally followed is that the molasses are mixed with water and with dunder (i.e., the residue from the still) and fermented in vats by means of the yeast remaining in the vats and in the dunder. After fermentation the wash is distilled through retorts Nos. 1 and 2. The product of distillation is, according to alcohol strength, (*a*) rum ; (*b*) high wines ; (*c*) low wines. The low wines are put in No. 1 retort, the high wines in No. 2 for the next distillation. The colour is determined by the addition of caramel (burnt sugar). It is claimed that this does not in any way decide or affect the flavour of the rum.

The principal rums made in Jamaica are :—

(1) " German " Rums—these are rich in ethers which are mainly extracted by the German chemists, so I am told, and the residue sold (mixed, it is alleged, with potato spirit) to the West African market as " Jamaica Rum." These are also called " Tea " Rums, as they were bought by Russians for adding to tea.

(2) " Plummer and Wedderburn " Rums from Westmoreland and surrounding districts. These are rich flavoured rums, too rich for some palates ; they are the most frequent in the English market.

(3) " Common Clean " Rum. This is the kind generally favoured in the North part of the Island, and appears to be one that conforms more or less to a regular standard of production.

Progressive producers are beginning to be impressed by the need for the regularity of supplies of certain definite types of rum, without, of course, destroying their individuality of flavour. It seems clear that with some such classification of existing good quality rums and the bringing up to standard of the poorer types, this would enable the rum producers to combine to advertise. It was also suggested that, looking to the future, a Rum Liqueur might be matured and advertised, particularly to emphasize the high advantages of rum in all mixed drinks, especially for a cold climate.

Generally speaking, the Jamaica sugar industry needs more and better cane for its factories. The establishment of free Empire sugar into Great Britain would give all the stimulus necessary to rehabilitate the industry, but it must be accompanied by very considerably improved field work, careful accounting systems and further centralization and factory improvement. There appears to be no particular difficulty in obtaining the necessary labour. It is to be noted that while Trinidad and British Guiana have still large East Indian populations, there are very few East Indians to be seen in Jamaica.

We regret to record the death of Mr. John McNeil, head of the firm of Messrs John McNeil & Co., Ltd., Govan, Glasgow, who passed away last month at the age of 81. All his life Mr. McNeil took a keen interest in matters relating to sugar making and sugar machinery, and had the satisfaction in later years of seeing many of his own ideas become every day practice. He was well known to the older generation of sugar men all over the world, who held him in high esteem. John McNeil began his engineering apprenticeship with Messrs. W. & A. McOnie of Glasgow. leaving them eventually with the rank of Chief Draughtsman, to start in 1881 with the late Mr. Thomas Aitken the firm of Aitken, McNeil & Co. In 1896 this business was taken over entirely by Mr. McNeil, and continued under his direction, assisted by his two sons, as a private limited liability company (John McNeil & Co. Ltd.) till his death, up to which time he continued to take a most active part in the business. He was one of the original founders of the Engineering Employers' Federation, as well as of the British Empire Producers' Organization.

Cracking of the Brass Tubes of Evaporators, Heaters and Evaporators.[1]

By J. A. MARONIER.

INTRODUCTION.

During recent years one has frequently heard speak in sugar circles of the cracking of the brass tubes of triple-effects and pre-heaters apparently without the slightest cause, this occurring sometimes crossways, though generally longitudinally to the axis. The only reference to such occurrences it has been possible to find in the sugar literature of Java is an article by H. Th. WEISSENBORN,[2] where, in regard to a question regarding the settling of oil on the outside of the tubes of evaporators, he says: "I have asked the opinion of a number of chief engineers in regard to the value of tinned copper compared with brass tubes; five of them appeared to prefer tinned, because these seemed less liable to cracking across." In the general technical literature, however, much can be found regarding the cracking of brass goods, especially condenser tubes, after 1891, when, for the first time, a scientific explanation of the phenomenon was given. That great importance is attributed to the investigation of cracking is seen from the special committees appointed by scientific societies dealing generally with the corrosion of metals: the American Society for Testing Materials, in the U.S.A., the Institute of Metals, in England, and the Handelsschiff Korrosion und Metallschutz in Germany.

CAUSE OF BRASS TUBE CRACKING.

It appears from what has been published in the last ten years that although the cause of this cracking is quite well known, yet a certain means of guarding against the effect has not yet been discovered. Internal stresses are regarded as the cause; but, though these can be relieved by sufficiently annealing, this remedy cannot be always applied, since at the same time the quality of the metal demanded for certain special purposes disappears, e.g., that it must be "hard-drawn." It would, however, appear to follow from the investigations of G. MASING[3] that internal stresses in brass tubes having 65 per cent. of copper can be practically removed by a very careful annealing at a temperature between 200 and 300° C., that is below the temperature at which crystallization takes place, and this without the hardness of the alloy being diminished.

The first scientific contribution on this subject dates back to the year 1891, when it was accidentally discovered that the presence of internal stresses can in advance be identified in brass goods which would crack sooner or later. This was at the munition depot at Troisdorf, where the splitting of brass cartridge cases (the copper/zinc composition of which was 72/28 and 66/34) was investigated by Dr. BRUNSWIG.[4] He immersed the brass cases in a solution of 1 part of corrosive sublimate (mercuric chloride) in 100 of water, when within 5 mins. cracks appeared, which in all respects were similar to those occurring in the warehouse after many weeks. As the results of many experiments, it was concluded that: (1) Cracking takes place in the drawing, and after the drawing of insufficiently annealed parts of cartridge cases; (2) cracking is the result of a certain stressed condition; (3) brass goods having such stresses split quickly when their surface is attacked

[1] Translation (abridged) from an article published in the *Archief*, 1926, 34, No. 38, 1051-1082.

[2] *Archief*, (Verslagen, Afl. 4,) 1924, 179.

[3] *Zeitschrift für Metallkunde*, 1924, 257; 1925, 17.

[4] This latter is generally the composition (known as "two to one alloy") that is used for the manufacture of tubes employed for juice evaporators in cane sugar factories.—ED., *I.S.J.*

in some way or other mechanically or chemically ; and (4) this is best done by sublimate or other soluble mercury salt, by nitric acid vapour, by ammonia, and more slowly by oxidation and by air. Shortly after the sublimate test was replaced by the use of mercury nitrate, which at the present time is in general use in munition factories.

Applying this test it was found that heating to 250° C. for a few hours with small articles, and for a few days with larger apparatus, is sufficient completely to prevent cracking. If the temperature can be raised to 250° C. by immersing the articles in a bath of molten zinc chloride, then the time of annealing is much shortened. Later at Troisdorf the cartridge cases were automatically heated to 450° C. by passing them through heated pipes, the time of heating being regulated just so that cracking is prevented. This discovery gave rise to the elaboration of a great number of tests, described in recent technical literature, these dealing with the cracking of every kind of brass goods of the most varied composition, form, and manner of manufacture, principally, however, with condenser tubes, which form such an important item of marine machinery, being used for that purpose in great quantity.

Von Schwarz demonstrated by many experiments that the cracking of condenser tubes can only be ascribed to the presence of internal stresses, and further proved that between the outside and the inside of a tube very great strains exist, which can be brought about by the attack of scum from the condenser water, by its adhesion, or by both effects. Again, he showed that tubes which had been in use for years could suddenly split if when removing them for cleaning they were not sufficiently carefully handled. Even tubes in store, which therefore had been unexposed to injury, could split. Comparative tests showed that all split tubes showed greater internal stresses than sound ones, though the latter were not wholly free from such. These results were later confirmed by G. Masing and C. Haase,[1] Moore and Beckingsale,[2] and R. J. Anderson and E. G. Fahlmann,[3] and by many others.

Besides the mercury nitrate test, the latter two investigators used the following means of exhibiting internal stresses of brass tubes, and further of calculating them : Sector-shaped pieces from solid rods, and strips from tubes, are cut, these after removal bending up ; then from the inclination, and the degree of bending, the internal stresses can be calculated. But Rosenhain has pointed out that calculation in this way is not so simple, since the strip curves according to the middle line of the tube, so that actually the result cannot give a true indication of the state of strain. An " average stress " is then determined.

Other Literature.

At the 19th annual convention in 1916 of the American Society for Testing Materials, A. E. White read a paper[4] on " An Investigation leading to Specifications for Brass Condenser Tubes," the causes and prevention of the cracking being then discussed, and again later by the same Society in 1917 and 1918. Bengough and May[5] stated in 1922 that the generation of electrical currents by the scale from river and sea water played a part in the rapid corrosion of brass tubes. W. R. Webster[6] drew attention to the effect

[1] Paper read before the Deutsche Gesellschaft für Metallkunde.
[2] *Engineering*, CXVI, 322. [3] *Ibid*, CXVII, 378
[4] *Proceedings of the American Society for Testing Materials*, 19*th Annual Meeting*, 1916, *Technical Papers*, *page* 153 [5] *Engineering*, CXVI, 572.
[6] *Proceedings of the American Society for Testing Materials*, *Technical Papers*, 1917, page 147.

of the rate of rolling or drawing in manufacture on the quality of the brass. W. E. W. MILLINGTON[1] cited a case of "fatigue failure in brass tubes" which had passed all the tests, this being traced to vibration, the splitting ceasing when the shaking was prevented. W. FRAENKEL[2] reported ont he favourable effect of tinning. W. ROSENBERG,[3] chief engineering expert of the Norddeutscher Lloyd, pointed out that the occurrence of two kinds of crystals, the α and the β-alloys, gave rise to electrical currents, having as its consequence the de-zincification of the brass, so that in tests made in two steamers, in which the condensers were put under electrical tension, a great improvement was brought about, the "Adalia" using tubes of 62/38 alloy never requiring to replace a single one after seven voyages. A similarly favourable result was reported by the Manager of the Brighton Generating Station,[4] who applied the Cumberland electrolytic system, and no longer had any trouble with the cracking of his condenser tubes. J. AUSTIN[5] stated to the Shipping and Engineers' Society at Liverpool that in tests made with the condenser tubes of one of the Cunard steamers the application of a thin layer of bitumen paint had given good results, only 21 tubes having then to be replaced in three months, whereas formerly 441 out of a total of 28,500 was the number which had to be taken out and made good again. Finally, there are the American[6] and British[7] specifications for brass condenser tubes.

The Reversion of Nitrates in the Soil under Cultural Conditions in Mauritius.[8]

By W. CRAIG, M Sc., and F. GIRAUD.
Department of Agriculture, Mauritius.

PREFACE.[9]

This bulletin incorporates the results of certain investigations carried out in the Chemical Laboratories of the Department of Agriculture in relation to the changes which take place when quick-acting nitrogenous manures are added to the soil. They form a direct continuation of previous work in the same direction and are complementary to the extensive series of field trials which this Department has for many years conducted. These latter experiments have shown that when artificial nitrogenous fertilizers are applied to cane lands, which have already received dressings of organic manure and molasses, little or no effect is frequently observed. The researches reported in this bulletin appear to indicate that this is due to the influence of the organic matter, which causes the nitrogen of these fertilizers to revert to an unavailable form or to become converted into gas and so lost. In Mauritius the application of artificial nitrogenous manures is very widely practised, and the net result of these investigations is to show that a considerable part of the artificial manures so applied may very probably be unremunerative. This result is of profound importance to the sugar industry and should receive the most careful attention of all planters.

[1] *Engineering*, CXVII, 353.
[2] *Zeitschrift fur Metallkunde*, 1923, 96. [3] *Die Rohrenindustrie*, 1925, 19-20.
[4] *The Metal Industry*, 1924, 195. [5] *Engineering*, CXIX, 112.
[6] Published by the American Society for Testing Materials, New York.
[7] Published by British Engineering Standards Association, 28, Victoria Street, London, S.W. 1.
[8] Abridged from a Bulletin published by the Department of Agriculture, Mauritius.
[9] By Dr. TEMPANY.

INTRODUCTORY.

Large stores of plant food exist in the soil, generally in a condition not readily available to the crop. For this reason, this food material must undergo certain changes, which in the case of nitrogenous substances are brought about by micro-organisms; thus protein substances in the soil are successively converted into ammonia, and finally into nitrates. The organisms, which cause this conversion of protein nitrogen into nitric nitrogen, are ammonifying and nitrifying organisms. Others, such as *Clostridium* (isolated by WINOGRADSKY) and *Azotobacter* (isolated by BEIJERINK) have the power of fixing atmospheric nitrogen. *Bacillus radicocola*, which lives in symbiosis with leguminous plants, has also the power of utilizing atmospheric nitrogen, and it is for this reason that leguminous crops enrich the soil. The result of all these biological changes is that under certain conditions, the soil gains nitrogen from the atmosphere, and that the organic nitrogen thus produced is converted into the form most useful to the plant, namely nitrogen in the form of nitrates.

But under some conditions, changes of a different order occur. Thus nitrogen in the form of nitrates may, under bad conditions in the soil, be reduced to ammonia, protein, or even gaseous nitrogen. Where ammonia or organic nitrogenous compounds are produced by the reduction of the nitrates, the nitrogen has been rendered temporarily unavailable for plant growth, whereas on the other hand when gaseous nitrogen is liberated, a complete loss occurs. According to DORYLAND,[1] in the presence of a quantity of easily oxidizable carbohydrate material, e.g. sugar, not only is the production of ammonia and nitrate from the protein material lowered, but also some ammonia and nitrate pre-existing in the soil is assimilated and converted into protein. When it is realized that on the nitrate production in the soil depends its fertility to a large extent, the importance of the above statement may be realized.

In field experiments conducted by KRÜGER and SCHNEIDEWIND, on plots dressed with urine or nitrate of soda the addition of large quantities of organic material dung and straw depressed the crop, as compared with control plots, the former causing the least depression and the latter the greatest depression. This field experiment indicated that large applications of fresh organic manure do not themselves help the crop, but that they even diminished the effects of rapidly acting fertilizers like nitrate of soda or urea. The same conclusion has been reached by MURRAY, who studied the effect of straw on biological processes, stating that bacteria use the straw as a source of carbon, and use the nitrates (or in some cases, ammonium sulphate) as a source of nitrogen. Thus evidence has been collected in various parts of the world, of the harmful effects which may be incurred by the application of too large quantities of carbohydrate material to the soil, whereby the nitrate production is considerably depressed, and denitrification brought about.

PREVIOUS WORK ON EFFECT OF MOLASSES ON SOILS.

A considerable amount of work has been done in investigating the action of molasses on soil, to account for the increase of yield consequent upon its application. Thus EBBELS and FAUQUE concluded that the increased yield was due to the stimulation of the nitrogen fixation organisms by the molasses. On the other hand DE SORNAY[3] showed that there was only a small increase

[1] *Agricultural News*, Vols. 7, 9 and 10.

[3] "La Canne à Sucre a l'Ile Maurice; *Bull. de la Soc. des Chimistes de Sucr. et de Dist.* 1919, 38, 223, *I.S.J.*, 1920, 469.

in the nitrogen content under laboratory conditions, and expressed his opinion that the benefit is due to biological factors, the plant food constituents of the molasses being insufficient to account for the total increase. PECK[1] found that the application of molasses to the soil may not only not be beneficial, but even harmful, due to the depressing effect which the molasses has upon two biological processes of extreme importance, namely ammonification and nitrification.

The organism which displays the most important part in the fixation of atmospheric nitrogen in the soil is *Azotobacter chroococcum*, which requires a supply of easily oxidizable organic matter in the soil. It has been shown by various authors, PRINGSTEIN and KOCH,[2] and KOCH and SEYDEL,[3] that successive small applications of dextrose greatly stimulate nitrogen-fixation, but that where a soil is rich in nitrates, the nitrogen fixation organisms may derive the nitrogen necessary for the fulfilment of their life processes, not from the air but from the nitrates pre-existing in the soil. It is thus seen that by varying the conditions in which they live, the nitrogen fixation bacteria may be changed from a beneficial to a harmful organism. The depressing effect which the application of molasses to the soil has upon nitrification is well shown by TEMPANY and GIRAUD,[4] who found that the rate of nitrification in the treated soil was much slower than in the untreated for a period of three months. When this interval had elapsed nitrification in the treated soils proceeded very actively, much more quickly than in the untreated soil. WINOGRADSKY[5] has shown that the addition of 0·5 to 1 per cent. of dextrose or mannitol to a fertile soil results in an enormous increase in the number of *Azotobacter* present, whereas an increase in the amounts of nitric acid or ammonia in the soil results in a decrease in the number of these organisms. Thus when 0·005 per cent. of nitric acid was added to the soil, 95 per cent. of the *Azotobacter* disappeared.

Numerous field experiments with cane have been carried out by the Department of Agriculture in various parts of Mauritius, and particularly at Réduit and Medine, the canes having been grown under irrigation at the latter station. In the course of these trials, one fact has stood out very prominently, namely, that when organic manures are applied to the soil, artificial nitrogenous manures often produce little or no response. All examples of Mauritius soils so far examined have been rich in humus and in organic matter, the loss on ignition sometimes amounting to over 30 per cent. Consequently when heavy dressings of organic manures e.g. 20 tons of pen manure per acre, or 1 litre of molasses per hole, are applied, ideal conditions are formed for the conversion of the available forms of nitrogen into the non-available forms. Bulletin 15 (General Series) of this Department reports field experiments conducted on eight estates in different parts of the Island, and also at the Station at Réduit. The responses recorded to artificial nitrogenous fertilizers were very irregular, and in many cases instead of an increase in yield a depression occurred. In a further bulletin (shortly to be published) dealing with manurial experiments from 1918 to 1926, further evidence is adduced on the same point. In fact the evidence points so strongly in the one direction, that it is suggested that considerable sums of money are being expended on artificial nitrogenous fertilizers without obtaining adequate increase in the yield. TEMPANY and GIRAUD,[6] in lysimeter trials observed the effect of the application of molasses upon the rate of notification in soil. When molasses was applied to soil, nitrification for some months was

[1] PECK, S.S., H. S. P. A. Bull. 39 : *I.S.J.*, 1912, 115. [2] and [3] *Centr. Bakt.*, 1911, ii, 31, 570. [4] and [6] Bulletin No. 28 (General Series) ; *I.S.J.*, 1924, 94. [5] *Compt. rend.*, 1926, 182, 999, 1001.

almost entirely arrested, but after the effect of molasses had disappeared, nitrification proceeded at an increased rate, so that in a year, the total amount of nitric nitrogen recovered was greater when the soil had been treated with molasses that when it had not. One of the conclusions arrived at, namely that partial sterilization of the soil occurs, would seem to be borne out by WINOGRADSHY's[1] work above mentioned. They also stated : " The tendency of ammonia and nitrates to revert to the insoluble form is very marked in Mauritius soils and it seems not unlikely that molasses application may have the effect of neutralizing to some extent applications of nitrogenous fertilizer by causing the nitrogen to revert in this way." This seems to be a satisfactory explanation as to why no marked response to manuring with nitrogenous fertilizers is noticed. The present series of experiments were designed with the object of finding out to what extent denitrification may take place, when organic manures are applied to the soil at the same time as sulphate of ammonia or nitrate of soda. The first series was confined to the action of molasses of different manures; in the second fumier, green dressing and molasses were tried with nitrate of soda.

EXPERIMENTS : SERIES I.

Following six experiments were commenced at the beginning of October, 1923, and finished in July 1924, so that the biological actions taking place in the soil were allowed to proceed for a period of almost 10 months. *No.* 1 : 2 kg. of soil and 250 c.c. of water ; *No.* 2 : 2 kg. of soil, plus 60 grms. of molasses made up to 250 c.c. with water. *No.* 3 : 2 kg. of soil, plus 5 grms. of ammonium sulphate dissolved in 250 c.c. of water. No. 4 : 2 kg. of soil, plus 5 grms. of ammonium sulphate and 60 grms. of molasses in 250 c.c. of water. *No.* 5 : 2 kg. of soil, plus 7·5 grms. of sodium nitrate in 250 c.c. of water. *No.* 6 : 2 kg. of soil, plus 7·6 grms. of sodium nitrate and 60 grms. of molasses in 250 c.c of water. Before and after the tests the following analyses were made : water content : ammoniacal nitrogen ; nitric nitrogen ; organic nitrogen.

Following are the results obtained[2]: *Experiment* 1 : None of the figures were very significant, most coming within the range of experimental error. Changes of the order observed are the normal likely to occur in the soil. *Experiment* 2 : There was quite a considerable gain in the amount of total nitrogen, probably due to nitrogen fixation organisms, e.g. *Azotobacter*, which in the presence of easily oxidizable carbohydrates are able to fix atmospheric nitrogen. Ammonification had gone on to a certain extent, but no evidence was obtained of any nitrification. *Experiment* 3 : Here nitrification had proceeded with such vigour that of the nitrogen present in the original sample as ammonia, 63·77 per cent. had been converted into nitrates, whereas in the same period, only a very little, namely 5·8 per cent., had been converted into less readily available forms. It is seen from this experiment that in the absence of excessive amounts of organic matter nitrification proceeds very actively in this soil under the conditions of the experiment. *Experiment* 4 : The results of this test compared with those of the previous one are very striking. In this case as in the former a large proportion of the ammoniacal nitrogen, namely 64·8 per cent., was converted into other forms. But, instead of the greater part being converted into nitrates, it reverted to organic nitrogen, a less readily available form than is ammoniacal nitrogen. Nitrification had proceeded to a certain extent, but this action probably took place after all the sugar in the soil had disappeared. None of the ammoniacal nitrogen had been converted into gaseous nitrogen, so that the nitrogen was

[1] *Compt. rend.* 1926, 182, 999 1001. [2] Tables appearing in the original are here omitted.

not totally lost, but merely rendered unavailable. *Experiment* 5 : Changes of no great order took place, to the organic and ammoniacal nitrogen having increased slightly at the expense of the nitric nitrogen. Only a slight reversion of the nitrates took place, in spite of the fact that the concentration of the nitrates is much higher than would ever be found in cultivated soil. *Experiment* 6 : Here again the application of molasses to the soil so altered the conditions in that soil that the biological changes normally taking place have been considerably altered. Within the period, 91 per cent. of the nitric nitrogen originally present were converted into other forms. As would be expected from the results of Experiment 4, not much of the nitric nitrogen was changed into ammoniacal, but 78 per cent. of the original nitric nitrogen was converted to organic nitrogen. A slight loss of nitrogen may have taken place in the gaseous state.

When those results are examined the outstanding fact is the very pronounced effect which molasses has upon nitrification. If comparatively large applications of molasses are applied to a soil in which normally nitrification proceeds fairly rapidly, such a change in conditions is brought about that instead of ammonia undergoing nitrification, it is reverted to organic nitrogen. Not only does the application of molasses affect the ammonia content of the soil, but also the nitrates pre-existing in the soil, causing them to be reverted to other forms, to ammonia to a slight extent, but chiefly to organic nitrogen. Thus it would seem that the application of molasses and nitrates together is an incorrect method of manuring, in that the rapidly acting manure is likely to be destroyed as a result of the bacterial action induced by the easily oxidizable carbohydrates added.

Experiments : Series II.

In the above experiments evidence of reversion of nitrates in the presence of molasses was obtained. Consequently the second series of tests was designed to find to what extent this reversion took place in the presence of various organic manures, the following six experiments being carried out in duplicate. *No.* 1 : 2 kg. of soil, and 7·5 grms. of sodium nitrate. *No.* 2 : 2 kg. of soil, plus 7·5 grms. of sodium nitrate, plus 60 grms. of molasses in 250 c.c. of water. *No.* 3 : 2 kg. of soil. plus 7·5 grms. of sodium nitrate in 250 c.c. of water and 50 grms. of green dressing. *No.* 4 : 2 kg. of soil, plus 7·5 grms. of sodium nitrate in 250 c.c. of water, plus 50 grms. of dry fumier. *No.* 5 : 2 kg. of soil, plus 7·5 grms. of sodium nitrate in 250 c.c. of water, plus 50 grms. of green dressing, plus 60 grms. of molasses. *No.* 6 : 2 kg. of soil, plus 7·5 grms. of sodium nitrate in 250 c.c. of water, plus 50 grms. of dry fumier, plus 60 grms. molasses.

Following are the briefly results obtained : *No.* 1 : Only a slight reversion of nitrates occurred with an increase in the amount of ammonia. With regard to the organic nitrogen, slow changes were brought about with the consequent production of free nitrogen, as quite a considerable amount of nitrogen was lost. *No.* 2 : Here very considerable reversion of the nitrates took place, both the organic and ammoniacal nitrogen having increased at the expense of the nitric nitrogen. Since there was a reduction in the amount of total nitrogen some of the nitric nitrogen was converted into gaseous nitrogen. Thus, not only has a large amount of the nitric nitrogen been rendered less readily available to the plant, but part has been actually lost. *No.* 3 : Here rather different results were obtained, a smaller amount of nitric nitrogen reverting but no estimate can be made as to the form into which it had been converted. *No.* 4 : Here the reversion of nitric nitrogen was still less, but then there was a large loss of nitrogen in the gaseous state derived in the

main from the organic nitrogen. *No.* 5 : Large amounts of nitric nitrogen were converted into other forms, the ammoniacal especially having increased, only relatively small losses occurring in the organic nitrogen. *No.* 6 : Here there was a marked reversion of nitric nitrogen, all the other forms of nitrogen increasing at the expense of the nitrates, viz., ammonia, organic, and gaseous.

GENERAL DISCUSSION OF RESULTS.

Experiments Nos. 2, 5 and 6 all included molasses, whereas 3 and 4 did not, so that it is seen that in these trials molasses had a very marked effect in helping in the destruction of nitrate in the soil. Dried green dressing and dried farmyard manure had a limited action on the nitrates in the soil, but the depression caused by either was much less than that caused by molasses ; the farmyard manure moreover had less effect than had the green dressing. When these two substances were added to the soil in addition to molasses, the depression in nitrates was less than that caused by molasses alone. As can be seen, with molasses alone, 72·9 per cent. of the nitric nitrogen was reverted, with molasses and dried green dressing only 53·8 per cent., and with molasses and farmyard manure 63 per cent.

According to DORYLAND,[1] addition of a small percentage of sugar lowers the ammonification, and therefore, of necessity, lowers nitrification. In this case it seems that the bacteria of the soil have first of all derived the energy necessary for their existence by means of oxidizing the ready available organic material, i.e. the molasses. When this source of energy is completely finished the bacteria may derive their energy from the ammonia or nitrates already existing in the soil. According to THORNTON[2] when a nitrogenous source of energy predominates, ammonia is released, but when a non-nitrogenous source predominates, it may be assimilated. In the experiments under discussion it is seen that when a large quantity of molasses is added to the soil, it has the effect of causing the disappearance of large amounts of nitrates.

In the case of Mauritius soils, the loss on ignition is great, which would appear to indicate a large percentage of organic matter. This view is supported by the estimation of organic carbon in the same soils so that the soils of the cane fields seem abundantly supplied with organic matter. The tendency of local practice is not to deplete the supply of organic material, but rather to increase it by returning all the cane trash to the soil and also by large applications of pen-manure. Furthermore, sugars are regularly applied to the soil both as molasses and as scums, so that similar conditions may be expected in the soil to those existing in the experiments under discussion, where molasses and organic manures were added. Thus, although the molasses is not applied at the same time as the nitrogenous fertilisers, yet it is only to be expected that reversion of a serious order should take place. If the magnitude of this reversion be such that only little nitrogen in the form of nitrates be left in the soil for the use of the plants, then it cannot be expected that the crop should show much response to nitrogenous fertilizers. As stated before, many field experiments have been done, under the direction of the Department of Agriculture, Mauritius, where little or no response to manuring with nitrate of soda or sulphate of ammonia has been seen, which seems to indicate that the readily available nitrogen which is supplied to the soil is not being absorbed by the crop. Thus the results of field experiments and of this investigation regarding the nitrogen cycle in the soil are seen to support one another, the former indicating non-response to readily available nitrogenous fertilizers ; the latter showing that in the presence of large amounts of organic matter,

[1] *Loc. cit.* [2] "The Micro-organisms of the Soil," by Sir JOHN RUSSELL and others, p. 33.

especially sugars, reversion of a very serious nature does take place, rendering the nitrogen unavailable to the crop.

It is thus seen that the lysimeter experiments conducted by TEMPANY and GIRAUD,[1] and the experiments now described, are complementary to one another. In the former it was definitely shown that nitrification was practically suspended for some months, in the later evidence is obtained of a serious reversion taking place in the nitrates and ammonia pre-existing in the soil when organic manures are added at the same time. There two factors, therefore, in all probability account for the lack of response to manuring with artificial nitrogenous fertilizers, which has been noticed in the field experiments.[2]

Another fact which may be of importance may be obtained from the results of the present series of experiments. Up to the present denitrification has been considered as a whole, but it must be remembered that denitrification consists of two totally different processes : first of all it consists of the process, whereby nitric nitrogen is converted into organic nitrogen, i.e. the reverse of nitrification ; secondly it also comprises the process in which nitric nitrogen is set free to the atmosphere as gaseous nitrogen, i.e., the reverse of nitrogen fixation. Thus it is quite possible that although the denitrification caused by two different manures may be the same in quantity, yet the final products may be vastly different. Addition of molasses or of dried green dressing does not seem to have increased the loss in total nitrogen ; it would seem therefore that the action of these two manures is to bring about the reversion of nitric nitrogen to an organic form, not to set it free as gaseous nitrogen. It would seem that the application of fumier tends to encourage the liberation of gaseous nitrogen from the nitrates pre-existing in the soil. MURRAY showed that though straw had a decided harmful effect upon nitrates accumulation in the soil, yet its effect was not to cause a loss of nitrogen in the gaseous form, but merely to transform it to some other form of nitrogen. Thus it would seem that this effect of the fumier is due chiefly to the dung. This may be an important point in the conservation of the soil nitrogen, as nitrogen reverted to the organic form is not lost, but merely rendered unavailable for a certain length of time, whereas a total loss occurs when gaseous nitrogen is evolved.

CONCLUSIONS.

(*a*) Under the conditions in which this investigation was carried out, the application of large amounts of molasses causes nitrification to be arrested, and causes ammonium compounds to become converted into organic nitrogenous compounds. (*b*) Nitrates which are present in the soil are on the addition of large amounts of organic matter to the soil reverted to less readily available forms. Molasses causes the greatest loss in nitric nitrogen, dried green manure and dried farmyard manure following in the order named. (*c*) Molasses and dried green manure do not seem to cause any increase in the loss of nitrogen in the gaseous form, whereas with farmyard manure a big increase in this loss occurs.

The Highlands of Kenya have the great advantage of two planting seasons each year. It is therefore possible to have canes ready for the mill during the whole 12 months of the year. This enables the factories to run continuously, and obviates the necessity of closing down during the off season, as is the custom in all other sugar-producing countries except Peru.[3]

[1] *Loc. cit.* [2] Bulletin No 14 (General Series).
[3] *Times Trade Supplement.*

Sources of Error in the Colorimetric Determination of *pH* Values.[1]

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The purpose of this paper is to call attention to some of these sources of error, particularly in the application of this method to refinery practice, which includes solutions of varying degrees of buffer capacity, as slightly buffered or unbuffered solutions are extremely susceptible to slight changes in manipulative and other conditions. The indicator covering the range of *pH* values most frequently encountered in sugar refinery practice is bromthymol blue, and practically all the results here recorded were obtained with this indicator.

FAULTY MANIPULATIVE DETAILS.

Faulty apparatus.—Glass comparison tubes sometimes vary greatly in diameter, making correct comparisons with the standard tubes impossible. Even tubes having fairly uniform diameters were frequently found to be incorrectly graduated. Thus, in one batch of such tubes the supposed 10 c.c. marks were found to correspond to 9·0, 9·2, 9·4, 9·5, 10·0, 10·5, and 11·8 c.c. *Dilution.*—It is the almost universal practice in sugar-house laboratories to dilute dark solutions with indeterminate amounts of distilled water, despite the fact that such dilution can lead to decided errors; 50 c.c. of a washed sugar liquor, originally testing 6·8 *pH*, gave results on progressive degrees of dilution with distilled water of *pH* 7·0 varying from *pH* 6·9 with 6 c.c. of water to 57·0 with 100 c.c. of water. These changes are probably due to alterations in the degree of dissociation of the complex mixture of salts and other substances present in sugar solutions. It is evident that sugar liquors cannot be diluted indiscriminately if accurate results are to be obtained. *Dried tubes.*—Errors may be caused by drying the comparison tubes in the water oven before use. With unbuffered solutions, *pH* determinations made in such tubes will almost invariably show higher *pH* values than those made in tubes after rinsing with the solution. This is probably caused either by the solvent action of the water on the glass itself, or else by the small amount of salts left upon evaporation of the water. *Mixing dye and sugar solution.*—It was early found that closing of the comparison tubes with the finger and shaking led to contamination by the acid excretions of the skin. Although far from ideal, the most practical method for mixing the dye with the sugar solution seems to be that of pouring back and forth several times between two tubes which have previously been rinsed with the solution under test. A far more satisfactory method, although quite cumbersome, would be to use Pyrex tubes fitted with ground-glass stoppers; this procedure would also prevent absorption of carbon dioxide from the air.

Storage of dye solutions.—It is frequently recommended that reagent bottles for storage of buffer and other solutions be coated with paraffin or beeswax. If this is done great care must be exercised in the selection of a proper wax, as the ordinary paraffin has a distinctly acid reaction. Pyrex glass bottles have been found much better suited to this purpose. If used for storing indicator solutions, such as bromthymol blue, ordinary glass shows a decided alkaline reaction, particularly around the ground necks and stoppers. Upon prolonged storage the bromthymol blue becomes progressively more alkaline, so that *pH* determination, when made with an old indicator solution, may be much in error. But with storage in Pyrex glass bottles, if they remain

[1] Paper (here abridged) presented before the Division of Sugar Chemistry at the 72nd Meeting of the American Chemical Society, Philadelphia, P.A., September, 1926.

unopened, bromthymol blue shows no change even after prolonged periods. If, on the contrary, the bottles are frequently opened, the reaction of the indicator dye becomes progressively more acid, as evinced by a gradual change from a greenish blue to a yellow-green. The change in reaction of the dye solution is therefore evidently the resultant of the extraction of alkali from the glass, and of absorption of carbon dioxide from the air, the former being the preponderating reaction in the case of ordinary glass, and the latter the only reaction in the case of Pyrex. It is therefore recommended that where weakly buffered solutions are to be tested, the dye solution be kept in a Pyrex glass burette supplied with a soda-lime tube, or else be siphoned directly out of a Pyrex stock bottle protected by a soda-lime tube. *Fading.*—It is advisable to make comparisons of tested solutions with the standard promptly, as it has been observed that, particularly with dilute, slightly buffered solutions, the colour produced begins to fade almost immediately after mixing the dye and solution.

METHOD OF PREPARATION OF BROMTHYMOL BLUE.

In preparing solutions of indicator dyes, it is frequently the custom to dissolve them directly, without neutralizing with sodium hydroxide. In the case of acid dyes, such as bromthymol blue, the acidity precludes the possibility of obtaining reliable results. Where the proper procedure is adopted, that of neutralization with sodium hydroxide, care must be exercised to use the correct amount of NaOH for the dye in question. Even slight deviations will lead to serious errors in *pH* values, especially in the case of weakly buffered solutions. In the preparation of solutions of bromthymol blue the method recommended by CLARK[1] is ordinarily employed. This consists in neutralizing 0·1 grm. dye with 3·2 c.c. 0·05 N sodium hydroxide and diluting to 250 c.c. But it was found that by using a solution so prepared incorrect results were obtained in the case of unbuffered solutions.

Successive lots of bromthymol blue solutions, even when purchased from the same source, have been found to give widely varying results. This was first brought forcibly to the writers' attention by variations in their appearance, some lots having a greenish blue colour by transmitted light, others varying from this to a deep purple. Two successive batches of this dye from the source gave the results shown in the following table :—

Solution.	First Lot.	Second Lot.	Difference.
6·8 *pH* buffer solution	6·8	6·8	0·0
7·2 *pH* buffer solution	7·2	7·2	0·0
Washed sugar liquor	7·0	7·0	0·0
No. 4 yellow liquor from char filters	6·4	6·4	0·0
No. 3 liquor from char filters	6·2	6·2	0·0
White liquor from char filters	6·0	6·2	+0·2
Extra white liquor from char filters	6·8	7·0	+0·2
Distilled water	6·6	6·9	+0·3
Double distilled water	6·9	7·2	+0·3

STANDARDIZATION OF BROMTHYMOL BLUE.

Considerable differences are shown in the *pH* values of those solutions which are weakly buffered, but no differences in the case of strongly buffered solutions. Such differences are probably caused either by variations in the amounts of sodium hydroxide used in the preparation of these indicator solutions, or by variations in the compositions of the dry indicators themselves

[1] "Determination of Hydrogen Ions," Second Ed., p. 80.

before such preparation. MICHAELIS[1] states : The indicator method can only give correct results if the *pH* of the fluid under investigation is not altered by the addition of the indicator. If, as is commonly the case, the indicator is either an acid or a base, this condition will only be satisfied if the nature of the fluid be such that it is sufficiently well buffered to prevent such changes of reaction as the indicator might otherwise cause.

To demonstrate this fact two solutions of bromthymol blue were used, one prepared by CLARK's method, and the other containing approximately seven times as much sodium hydroxide. These two indicators were used in determining the *pH* value of a 7·2 standard buffer solution, and both dyes gave identical results of 7·2. When these two dyes were used for testing distilled water, however, the abnormal dye gave a *pH* value greater than 7·6, or beyond the range of the indicator. The normal dye gave *pH* 7·2. This shows forcibly that a very considerable variation in the alkali content of the dye solution will have no influence upon tests made on buffered solutions, but that this difference becomes serious in the case of unbuffered or slightly buffered solutions. It is therefore evident that where dye solutions are to be used with both highly and slightly buffered solutions, such as are mêt with in in refinery practice, their standardization against buffered solutions is inadmissible.

DAWSON[2] describes a method for the preparation of water of *pH* 7·0, which consists in boiling off one-third of the volume of a good distilled water, and then storing the remainder out of contact with air, in insoluble glass containers. Although various objections have been raised as to the validity of DAWSON's figure of *pH* 7·0, the writers have found this water to be a simple and quite satisfactory reference standard for the preparation of bromthymol blue indicator solutions, especially as waters repeatedly so prepared will give identical colour readings with the same indicator solution. Accordingly, their method of standardization of bromthymol blue is to dissolve the indicator in "Dawson" water to which successive small amounts of a dilute solution of sodium hydroxide are added, until the indicator solution tested against the water of *pH* 7·0, as given above, gives a colour corresponding to that given by the same indicator solution when tested against a buffer solution of exactly 7·0 *pH*. By this procedure the addition of a fixed and probably inaccurate amount of sodium hydroxide is avoided, and just sufficient is added to bring the dye to the point of neutrality.

The Skoda works, the largest iron, motor, and aeroplane works in Czecho-Slovakia, which are also engaged in the production of sugar machinery, showed a net profit for 1926 of £270,000.

After considering the possible advantages of turning to the production of cargo sugars, Mauritius has decided in favour of a standard quality of whites. Central factories are to be erected, and a reserve fund is to be created by means of an export tax of 2 cent. per 100 kg.

Some vacuum pan figures for Java have been published for the year 1925-26. In the 177 factories there, the total number of pans was 915, the ratio of heating surface to capacity being 1·28 sq. ft. to 1 cub. ft. Of these about 69 per cent. were the usual coil type ; 14·7 per cent. were calandria pans ; 2·5 per cent. had double bottoms, the remainder being combined systems, as calandria and coils, or calandria and double bottoms. About 8 per cent. of the total number of pans was reserved for the production of solidified molasses. Of coil pans the maximum capacity was 340 hectol., the capacity favoured for calandria pans being 200 hectol.

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[1] "Practical, Physical, and Colloid Chemistry," Second Ed., p. 47.
[2] *J. Phys. Chem.*, 1925, 29, 551.

Recent Work in Sugar Cane Agriculture.

Sugar Cane Breeding—Indications of Inheritance. T. S. Venkatraman. *Memoirs of the Department of Agriculture in India. Botanical Series. Vol. XIV, No. 3, January,* 1927.

This paper may be considered, in some sort, as a complement to a previous Memoir issued from the Cane Breeding Station, in which a number of morphological features of the seedlings raised were passed in review; with, however, an important addition on the root characters, which the author has somewhat carefully studied more recently. It is a common observation that sugar cane seedlings with the same parentage vary among themselves a good deal more than is usual among plants; and various suggestions have been made, from time to time, as to the probable cause of this. Perhaps the most appealing of these suggestions is that which points to the very large number of chromosomes in the nucleus of the cane plant, as indicating a very complex phylogenetic structure; the combinations and permutations possible in such a case reach to very high figures, and it has been considered by some authors that it would be a rare accident if two seedlings were found in the same batch with a strong resemblance to one another. It is the object of the author to collect and place on record some of the observations made on certain morphological characters of numerous batches of seedlings, in which individual characters were seen to be strongly inherited.

In spite of variations in every direction it is, nevertheless, in most cases easy to note a general family likeness in any large batch of seedlings when comparing them with neighbouring batches raised from different parents; but it is a very different thing to reduce this resemblance to its component parts, and analyse it statistically—a piece of work requiring much time and concentrated attention. The task of recording and tabulating the characters dealt with in such large batches of seedlings as are dealt with in this paper must have been very laborious; and the author is to be congratulated on having taken the trouble to compile the figures presented. One example of the work is taken, somewhat at random, and summarized here, namely, the shape of the cane joint.

(1) The inheritance of this character. The Local Red and the Local Striped varieties have practically straight sided joints. In 362 seedlings of the first examined, 98 per cent. were straight sided and 2 per cent. had joints which thickened upwards. In 228 seedlings of the second, 97 per cent. had straight sided joints, 1 per cent. had those which narrowed upwards and 2 per cent. had biconcave. Ashy Mauritius has joints which thicken upwards and, of 82 of its seedlings, 77 per cent. showed this character, while 23 per cent. had straight sided joints.

(2) Influence of the pollinating parent on the shape of the joint. Vellai (a local white or yellow cane) and Striped Mauritius have straight sided joints, and when crossed, none of the 68 seedlings showed upward thickening. When Vellai was crossed with Ashy Mauritius, however, of 120 seedlings, 40 per cent. resembled the latter plant. POJ 213 and Mauritius 55 have barreled joints and when crossed, of 40 seedlings, 96·5 per cent. were also barreled, while the remainder were biconcave. Katha and Saretha have biconcave joints and were used for pollinating POJ 213; in the first case, 80 per cent. of the 45 seedlings were barreled and 20 per cent. biconcave: and in the second (95 seedlings) 74 per cent. were barreled and 26 biconcave.

The following characters are similarly treated, and give generally

similar results : Vigour of growth, habit of plant, tillering ; leaf width, tips, colour of sheath and ligular processes ; cane, thickness, length, ivory (corky) markings, splitting, circlets of hairs. With respect to the root, owing to well known difficulties, it was not possible to collect sufficient data for presentation in the form of tables ; and as a natural consequence this part of the paper is more interesting, for diagrams are resorted to. The depth of rooting, penetration of stiff soil, and resistance to waterlogging are dealt with ; while other characters, such as time and rapidity of root development, length of functioning period of set and shoot roots, and periodicity in the development of the latter are merely stated as having shown indications of inheritance, without giving any examples.

(*a*) *Depth.*—Tropical cane varieties are characterized as a whole by a comparatively shallow rooting system—which the author regards as being largely responsible for their poor performance under field conditions in northern India. Some of the Indian cane varieties and *Saccharum spontaneum* have, on the other hand, deep root systems. Co 205 is a cross between a tropical cane and *Saccharum spontaneum,* and photographs are shown of excellent fields of this seedling grown (1) without irrigation, and (2) under swampy conditions, in north India, thus combining the opposite characters of drought resistance and tolerance of waterlogging.

Three shallow rooted forms, POJ 213 × B 6388, POJ 1547 × B 6388 and POJ 2690 × 6388, were dissected out and diagrams are given of five average root systems of each. Opposed to these are diagrams (again five each) of the root systems when Co 205 was substituted for B 6388 in crossing, the strong vertical roots in all of the latter are very marked, as showing the effect of the male parent, Co 205.

(*b*) *Penetration of stiff soils.* The plate illustrating this is specially interesting, as showing the result of the author's method of dividing the roots of a set, and leading the divisions into pots filled with different kinds of soil, namely, stiff clay and sand. The root systems of 247 B, Hemja, and *Saccharum spontaneum,* treated in this way, were dissected out about two months after sprouting, and the contrasts are very marked. The roots, held in place by two layers of wire netting, one below the other, were photographed after dissection, and line drawings then made of them. All three are shown as having reached the lower wire netting in the sand half ; in the stiff clay, on the other hand, 247 B has stopped at the first netting, a few of the Hemja roots have passed to the second layer, while the roots of *Saccharum spontaneum* are, if anything, better developed in the stiff clay, although somewhat fewer have passed the lower netting. Co 205 is given as an example of a seedling in which this penetrating power of the roots of *Saccharum spontaneum* has been passed on by inheritance.

The last characters dealt with, namely, the character of the juice, and liability to smut, are again treated statistically in tabular form. The five chief groups of Indian canes have been studied as to their liability to smut, and the following are the results : Mungo group, 39 varieties examined, and none found susceptible ; Pansahi group, 21 varieties studied, and 10 per cent. found susceptible ; Sunnabile group, 12 per cent. of 23 varieties attacked; Nargori group, 65 per cent. of 17 varieties ; and Saretha group 72 per cent. of 23.

POJ 213 (a descendant of the Saretha alliance) showed 8 per cent. infection at Coimbatore, and this seedling was pollinated by five other varities with 7, 8, 10, 20, and 60 per cent. infection ; the results in the seedlings raised being 1·7, 3·2, 3·0, 5·0, and 12·0 respectively.

There are a few minor points in which the presentation of this interesting paper might have been made clearer. For scientific purposes it is always desirable to retain well known names; e.g., " Local Red " and "Local Striped" have presumably replaced the Karun and Chittan in former Memoirs. The diagram illustrating leaf width is not very convincing ; and simple measurements in centimetres would have been better than the varying thicknesses of the lines drawn—especially as the leaves have been drawn as seen and not as flattened out on the plane of the paper. Some difficulty was experienced by the writer in reading the Table dealing with the colour of the leaves. The terms " pale green," " green " and " other than green " are introduced ; and, if the author's argument is upheld by the figures " pale green " would count among the " other than green " ; anyhow, there is a doubt. Then with regard to the thickness of seedling canes, would it not have been better to judge this by the thickness when they were grown from sets ? The canes of a seedling differ inordinately among themselves in thickness, but this is largely ruled out, if we are not mistaken, when it is grown from sets. Lastly, it would have been interesting to know which were the pollinating parents ; and as there are eight seedlings shown, there is of course no " central one in the picture."

Sugar Cane Moth Borers (Diatraea spp.) in British Guiana. **H. E. Box**, *Entomologist, Central Aguirre Sugar Company, Porto Rico. Bulletin of Entomological Research, Vol. XVI., Part* 3, *January*, 1926.

The stem borers may be described as the " hardy annuals " if not perennials among the various pests which are found in the fields wherever the sugar cane is grown. Planters have become quite accustomed to the toll taken by them at the mill, and when this is great have adopted such methods for reducing their numbers as occurred to them ; but in most cases a certain quantity of bored canes has come to be regarded as a necessary evil. The injury done to the crop is always easily seen, and a very large mass of literature has accumulated from the sporadic studies of various entomologists ; cane borers have been studied everywhere and we know a great deal about them, and in many places they are under a fair amount of control. It appears to be rather a curious fact, that, in these circumstances, there are still two countries, with widely different natural conditions, which can be pointed to, where the cane borers are increasing rather than diminishing in their virulence, and even threatening the very existence of the industry : namely, Louisiana and British Guiana.

The conditions in British Guiana are all in favour of the borer ; and, although its collection and destruction has become more or less a routine practice on estates, no accurate estimates have been made as to the losses incurred by its presence. It is only recently that the matter has been at all seriously studied from a scientific point of view, although the necessary warning was uttered, as long ago as 1879, as to the dangers foreshadowed. It is owing to the enterprise of a progressive sugar company in the country that this study has been taken up, and that for several years an entomologist has been employed solely for the reduction of the evil over its 3000 acres of cane. One of the reports sent in appears to throw so much light on the problem, of interest to all cane growers, that it has been thought worthy of a somewhat extended discussion. Most of our readers will be familiar with the main facts concerning these pests ; but it is useful, nevertheless, occasionally to revise one's knowledge as new ideas and aspects come to the fore.

Recent Work in Sugar Cane Agriculture.

This paper gives results obtained by H. E. Box, engaged during the best part of three years in studying the most important sugar cane pests in British Guiana. It appears to have been written in Porto Rico, where the author seems now to be holding a somewhat similar appointment—an island where the sugar cane insects have undergone a very close scrutiny; and this fact should lend additional weight to the conclusions arrived at. Three species of Diatraea have been found in British Guiana attacking the sugar cane, but of these two only are important—*D. saccharalis* and *D. canella*. The latter is chiefly found on the young shoots, while the former causes most injury to the grown canes. Both of them infest a wild plant, the "razor grass" (*Paspalum virgatum*) which grows everywhere on the "dams" between canefields and on waste places near; and yet no efforts at eradicating this fertile source of moth borers appear to have been attempted in the past. It is stated that a stool of this grass may have anything up to 75 separate stalks, and that not infrequently 50 per cent. of these have borers in them.

Life history.—The local life history of the two Diatraeas has been worked out, and runs the usual course. Eggs are laid on the upper surface of the cane leaves in groups, the individual eggs overlapping like the scales of a fish, and numbering on the average 35 to the group. These hatch out in 7-8 days. The first meal is made on the epidermis of the leaf, but within 24 hours an entry has been made into the stem or, if this is too hard, the midrib of the leaf. The caterpillar, after its entry, feeds on the softer parenchymatous cells between the hard strands for three to five weeks; and during this time it greatly increases in size, and moults or casts its skin five times. On occasion it reaches the surface and emerges from the cane, either re-entering at another place or on a different cane. When nearing maturity it again tunnels to the rind and cuts a round hole leaving a thin piece of the outer surface as a sort of door at the end of the passage for the exit of the moth, which cannot penetrate any solid substance. It then enlarges the burrow and lines a portion with silken threads; and rests for about 36 hours, before entering the pupal stage. In this stage the change takes place from the caterpillar to the fully developed moth; and this change takes eight days to accomplish. The moth is light-shy and has protective colouring, so that it is seldom seen, flitting for a few seconds in the air when disturbed, and then immediately seeking some hiding place. Mating and oviposition take place at night.

Damage done.—Only the upper part of the cane is used for seed in British Guiana, and is cut up into short pieces for this purpose; being tender, this part of the cane is that most attacked by the moth borers. From data collected during the three years, the author states that about 20 per cent. of all seed planted contain live borers inside. But the buds of most of these germinate in spite of this; more serious damage is probably done to the seed by the infection of the cavities by disease organisms, of which the common "pineapple disease" is most frequent. Immersion in Bordeaux mixture destroys this fungus, and in an experiment was found to materially improve the stand of cane produced. The author has invented a machine for the rapid treatment of large numbers of seed pieces with this fungicide.

The shoots of the young plants are in these circumstances quickly invaded, and the terms "primary" and "secondary" infestation, familiar in mosaic literature, have been introduced into the description. The former is caused by the living pests in the seed planted, while secondary infestation depends chiefly on the laying of eggs by moths from elsewhere: other canes, other fields, or certain neighbouring grasses. The two classes of infestation

can be readily separated by comparing the stage of a caterpillar with the age of the plant in which it is found. The young shoot is seriously injured by the rotting of the tissues around the tunnel; and cutting out not only removes this diseased tissue and the borer, but makes healing easier and stimulates subterranean buds to start growing.

But the injury to the ripening or mature cane is much the most serious; and the absence of reliable data in British Guiana as to its extent strikes one as rather curious, in that such data are available in Barbados, Louisiana and Porto Rico. Losses occur both in the reduced quantity of millable canes and in the quality of the juice, while bored canes have been noted as having more fibre than uninjured ones. But disease organisms and other insects take advantage of the borer holes to enter the canes; and the author has estimated, on different occasions, a loss of 25 per cent. of the crop through rind fungus, and 30 per cent. through weevil, both primarily induced by the moth borer. The two borers act in somewhat different fashion in forming their burrows: *D. canella* makes long, vertical channels passing through several joints, while *D. saccharalis* works sideways, cutting through the bundles, sometimes to the extent of two-thirds of the cross sections of the cane. The latter action of course leads to the breaking of many canes by the wind and passing labourers, and this is very noticeable just before harvest. On the whole, it was estimated by Box's predecessor Cleare that 20 per cent. of the crop is lost through Diatraea; and, while agreeing with this figure in general, the author considers that it is probably a conservative one.

Final infestation.—For the purpose of initiating research into such losses, the above term has been introduced, meaning the infestation at the time of harvesting the canes. Accurate figures of this are badly needed for establishing a standard; and the latter is required both for comparing losses in different regions, and for different varieties of cane. If such a standard were available it would also be easy to decide whether the losses were increasing or decreasing, and so on. The method of calculation adopted in Louisiana is simply to take 100 canes at random in a field, and count those injured by borers; the number of the latter will give the percentage. Thus, for the years 1912-17, the infestation in Louisiana was estimated on the average at 58·2 per cent. Applying this method, the figures obtained by the author in British Guiana are considerably higher. For respective half yearly seasons during his stay, they were 67·2 (46 fields), 80·3 (39), 85·7 (42), 95·9 (14), and 93·6 (16) per cent. It is believed that no other sugar cane country has such high figures; 272 counts were made at Berbice during the two and a half years, involving the examination of 27,200 canes. Only four counts showed 50 per cent. or less, whereas 62 gave over 90.

A slight modification was made in the method of calculations as the work proceeded, in that 20 canes were taken from five different parts of the field. But a more thorough-going examination was regarded as necessary, and for various reasons the author chose "joint infestation" rather than that of whole canes. This of course involved more labour, in that the joints were counted in each cane, and then the injured ones were also counted; and the percentage was made up of the whole of the injured joints as compared with the total number examined. That this method gives a truer result is confirmed by the fact that the figures obtained agreed very closely with the recorded factory losses, as shown by the number of tons of cane required in the different fields examined to make one ton of sugar; and a case is given showing the unreliability of the whole cane method by comparing two fields examined. One of these had 87 per cent. cane and 30 per cent. joint infes-

tation, while in the other the figures were 98 and 15 respectively. From the cane figures, the second field would be most heavily infested, but on a careful study it was obvious that the first field had suffered at least twice as much loss. The author therefore recommends that, for British Guiana, losses in the cane fields should in future be estimated by the joint infestation method.

The factors which influence the prevalence of borers in a field are carefully analysed, and may be briefly summarized as follows : One very important factor is the arrangement of the fields, so that young ones are not adjoining old ones, but there appears to be no arrangement by which this is or can be managed in this locality ; the proximity of razor grass is obviously a great danger, but no efforts have in the past been observed to effect its eradication. The author has applied this preventive to the 3000 acres under his control as an example of the ease with which it may be done ; while he points out that, by merely cutting and burning the grass, countless numbers of borers can be cheaply destroyed. Various ways exist for controlling the passing on of the borer in the seed, from selecting clean seed as is done elsewhere to merely planting the sets flat instead of slanting, and with one end emerging ; this flat planting under a light layer of soil prevents the moth from emerging, and the author has found that it is perfectly feasible in ordinary planting conditions. Six months' old seed nurseries are also suggested as likely to be a sound method of obtaining borer-free seed. The removal of surplus seed and pieces of diseased cane at once from the fields surely should not have to be insisted on, but apparently this is often not attended to ; while the extraordinary practice of sometimes planting the new crop before removing the old stubble is justly condemned. Burning the whole field before harvesting the canes is stated to be universal, and this has been abundantly proved to bear hardly on the parasitic enemies of the borers. These enemies would seem to be present in quite unusual numbers in British Guiana, and a list is given of those found in Berbice alone ; two parasites of the eggs, 14 of the caterpillar stage, and one of the resting pupa. Besides these, six predators have been noted, and the attacks of the mummifying fungus, *Cordyceps* (*Isaria*) *barberi*, reach a high figure during the wetter months. But a consideration of the whole question of control, and especially of the remarkable list of parasites deserves a separate treatment.

As regards burning, the author states that several planters have told him that, in the old days when Bourbon was planted, the canes were cut without being burned ; and that the moth borers were very much less severe than they have been during the last two or three decades. This is probably one of the factors of the environment of British Guiana canefields, which make it ideal for the spread of the borers. And there appear to be others also, for which the planters are more or less responsible, so that it is not entirely nature that is to be blamed.

C. A. B.

According to the U. S. Bureau of Labour,[1] sugar in the U.S.A. has advanced in price less than any other commodity, excepting "plate roast," its advance over the 1913 price being 29·1 per cent., whereas the advances for other articles of food were : meat, about 60 ; coffee, 70 ; bacon, 88·9 ; ham, 117·1, and potatoes, 135·3., the average advance of all food products being 61·6 per cent. Compared with its price in 1890, the increase in the cost of sugar is only 4 per cent., that of potatoes, for example, being 125 and bacon, 274 per cent.

[1] "Prices and Cost of Living" ; U.S. Department of Labour, 1927.

Per Capita Sugar Consumption of the Various Countries of the World.

We give below the figures of consumption per head in the various countries of the world, as compiled for us in kilos from various official sources by Dr. GUSTAV MIKUSCH, the Vienna statistician. We have added the corresponding figures representing lbs. avoirdupois.

SUGAR CONSUMPTION RAW SUGAR VALUE IN KILOS AND LBS. PER CAPITA.

	Kilos	lbs.		Kilos	lbs.
EUROPE—					
Germany	22·6	49·7	....	22·2	48·8
Danzig	20·5	45·1	....	23·3	51·2
Czecho-Slovakia	28·6	62·9	....	27·6	49·7
Austria	29·8	65·5	....	26·7	58·7
Hungary	11·0	24·2	....	10·2	22·4
Switzerland	37·9	83·3	....	38·0	83·6
France	24·2	53·2	....	23·1	50·8
Belgium	24·7	54·3	....	25·0	55·0
Netherlands	30·6	67·3	....	30·3	66·6
United Kingdom	41·6	91·5	....	40·6	89·3
Irish Free State	32·7	71·9	....	30·2	66·4
Poland	10·1	22·2	....	9·7	21·3
Russia	7·3	16·0	....	5·1	11·2
Denmark	54·0	118·8	....	49·8	109·5
Sweden	34·7	76·3	....	37·1	81·6
Norway	29·5	64·9	....	26·9	59·1
Finland	20·1	44·2	....	21·5	47·3
Italy	8·8	19·3	....	8·6	18·9
Spain	10·8	23·7	....	10·9	23·9
Portugal	10·5	23·1	....	10·9	23·9
Jugoslavia	7·2	15·8	....	7·0	15·4
Rumania	6·6	14·5	....	6 8	14·9
Bulgaria	5·7	12·5	....	6·0	13·2
Latvia	21·1	46·4	....	20·1	44·2
Esthonia	17·9	39·3	....	17·1	37·6
Lithuania	9·9	21·7	....	10·0	22·0
Turkey	3·7	8·1	....	3·3	7·2
Greece	10·4	22·8	....	10·5	23·1
Albania	3·7	8·1	....	3·7	8·1
Total Europe	16·8	36·9	....	15·8	34·7
ASIA—					
China	1·9	4·1	....	1·9	4 1
British India	11·9	26·1	....	9·8	21·5
Japan and Formosa	9·4	20·6	....	9·0	19·8
Java	4·7	10·3	....	4·4	9·6
Philippine Islands	—	—		—	—
Persia	7·9	17·3	....	8·3	18·2
Other Asia	3·9	8·5	....	3·9	8·5
Total Asia	6·2	13·6	....	5·4	11·8
AMERICA—					
United States	54·0	118·8	....	53·6	117·9
Hawaii	41·3	90·8	....	41·9	92·1
Porto Rico and Virgin Islands	31·3	68·8	....	31·7	69·7
Cuba	43·9	96·5	....	41·5	91·3
Canada	43·6	95·9	....	43·8	96·3
Brit. W. I. and Brit. Guiana	12·9	28·3	....	12·4	27·2

Per Capita Sugar Consumption of Various Countries of the World.

	Kilos	lbs	Kilos	lbs.
AMERICA—*continued.*				
French West Indies	5·9	12·9	6·0	13·2
Hayti and San Domingo	3·9	8·5	3·9	8·5
Mexico	9·9	21·7	9·9	21·7
Other Central America	12·1	26·6	12·3	27·0
Argentina	36·2	79·6	37·1	81·6
Uruguay	25·9	56·9	26·7	58·7
Brazil	25·5	56·1	24·4	53·6
Peru	10·3	22·6	9·9	21·7
Chile	23·5	51·7	23·0	50 6
Surinam	25·4	55·8	25·9	56·9
Other South America	4·2	9·2	3·9	8·5
Total America	38·5	84·7	37·6	82·7
AFRICA—				
Morocco	13·3	29·2	12·8	28·1
Algeria	9·5	20·9	9·5	20·9
Tunis	11·0	24·2	11·0	24·2
Egypt	7·8	17·1	7·5	16·5
Union of South Africa	18·9	41·5	17·3	38·0
Mauritius	17·9	39·3	15·4	33·8
Other Africa	0·5	1·1	0·5	1·1
Total Africa	3·5	7·7	3·4	7·4
AUSTRALIA—				
Commonwealth of Australia	62·4	147·2	61·7	135·7
Other Australia	28·3	62·2	28·5	62·7
Total Australia	51·8	113·9	51·2	112·6
WORLD CONSUMPTION	13·0	28·6	12·2	26·8

Amino Acids and Related Compounds in Sugar Products.

By J. A. AMBLER,
Carbohydrate Laboratory, Bureau of Chemistry, U.S. Department of Agriculture.

(*Continued from page* 385).

II.—APPLICATION OF THE METHOD TO THE STUDY OF THE ELIMINATION OF AMINO ACIDS DURING THE REFINING OF SUGAR.

As an illustration of its application, the method was used to follow the elimination of amino acids[1] during the refining of raw cane sugar. For this purpose the various products obtained from two experimental refinings of a raw sugar were used. These refining experiments were conducted by Mr. M. S. BADOLLET of the Carbohydrate Laboratory, to whom acknowledgment is gratefully made. All the bonechar filtrations were made with 60° Brix syrups at 85° C. under conditions as nearly uniform as possible. The evaporations were made in a small experimental vacuum pan. The

[1] The term "amino acid" is used for brevity in the remainder of this article to denote not only the amino acids themselves, but related substances, such as peptides, peptones, albuminoids and albumens, if present in the sugar product.

results obtained are given in Flow Sheet 1, the two experiments being indicated by the letters A and B. The percentages of nitrogen as amino acids are calculated on the weight of total solids.

The results show the accumulation of the amino acids in the affination syrup, the green and wash liquors and the molasses. This was to be expected, as the process of refining sugar is to a great extent a fractional crystallization of sucrose from impure solutions.

There is also evidenced another mode of elimination of the amino acids, namely, by bonechar. This is better shown by the series of experiments on char filtration given in Flow Sheet 2. These filtrations were also carried out by Mr. Badollet and were made on the same raw sugar used in the experiments recorded in Flow Sheet 1, and under the same conditions. In order to give the action of the bonechar a thorough test, the char-filtered liquor was passed repeatedly back over the char for a varying number of hours. Experiments C, D and E thus represent 5-hour cycles each, experiment F a 25-hour cycle, and experiment G a 25-hour cycle for the syrup but a 50-hour cycle for the char, effected by using the same char as in F with a new batch of syrup. After sweetening off, the char was washed with 1 litre of hot water, giving a solution which represents the wash-water going to the sewer. Percentages are based on the weight of total solids, and indicate the quantity of nitrogen present as amino acids.

These experiments show that the char removes from 70 to 80 per cent. of the amino acids from concentrated syrups. As soon as the concentration of the syrup drops during the sweetening off, the char begins to release the adsorbed amino acids and their concentration increases about 200 to 300 per cent. in the sweet-waters, and still further in the wash-water to the sewer. In Flow Sheet 1 there are three instances which seem to be exceptions to the results indicated in Flow Sheet 2, and concerning which the need of further investigation is indicated :—

(1) The filtered liquor from the washed raw sugar crystals lost none of its amino acids by char filtration. This may be because of the extremely small concentration of them present, which can well be at, or below, that which may pass over char without change, i.e.. small concentrations of amino acids may not be adsorbed by char to a material extent. This view is strengthened by the facts that the sweet-water from this filtration showed no indication of amino acids, and that the concentrations of amino acids left in the char filtered liquors in the experiments recorded in Flow Sheet 2 are always greater than that of the liquor going on the char in the experiment under discussion.

(2) Char filtration of the affination syrup does not remove as great a proportion of the amino acids as in the case of syrup of greater purity. The reason for this is not known at the present time.

(3) Apparently there is no appreciable change in the amino acid concentration during the char filtration of the molasses. There are other nitrogenous substances in molasses, and here it is possible that there may be a breaking down of protein or amino-acid-carbohydrate complexes under the combined influence of the temperature of the filtration (85° C.) and of the salts present in the molasses itself, so that the net result might be no apparent change, or even an increase, in the concentration in the filtrate.

The fact that the green and wash liquor from the granulated sugar (Strike 4) contains practically the same percentage of amino acids as the char-filtered liquor from which four strikes of sugar have been taken, in spite of the large quantity of sugar removed, is worthy of note. Similarly, in the

Flow Sheet I.

Raw sugar —A— 0·025%
—B— 0·025%
Washed with water and centrifuged

Washed crystals —A— 0·0015%
—B— 0·0018%
Melted, limed and filtered
Filtered liquor —B— 0·0020%
Char filtered
Char filtered Liquor —A— 0·0016%
Sweet-water —A—0·0%
Evaporated

Granulated sugar Strike No. 1 —A— 0·0%
—B— 0·0%
Green and wash liquors —A— 0·0011%
Evaporated

Granulated sugar Strike No. 2 —B— 0·0%
Green and wash liquor No. 2
Evaporated

Granulated sugar Strike No. 3 —B— 0·0%
Brown and wash liquor No. 3
Evaporated

Granulated Sugar Strike No. 4 —B— 0·0%
Green and wash liquor No. 4 —B— 0 0021%

Affination —A— 0051·%
—B— 0 057%
Limed and filtered through cloth (kieselguhr)
—A—
Char filtered
Sweet-Water —A— 0 064%
Char filtered liquor —A— 0·024%
—B—
Evaporated

Remelt sugar No. 1 —A— 0 0097%
—B— 0 0081%
Melted
—B—, limed, filtered through cloth (kieselguhr) and char filtered
Char filtered liquor evaporated
White sugar No. 1 —B— *trace*
Green and wash off White sugar No. 1
Evaporated
White sugar No 2 —B— *trace*
Green and wash off White sugar No. 2 —B— 0·048%

Remelt syrup No. 1 and wash liquor —A— 0·048%
Remelt sugar No. 2 —B— 0·048%
Remelt syrup No. 2 and wash liquor
Melted, limed, filtered through cloth (kieselguhr) Char filtered, Evaporated
Soft sugar —B— 0·0025%
Green and wash off soft sugar —B— 0·034%
Evaporated
Remelt sugar No. 3 —B— 0·053%
Final molasses —B— 0·23%
Char filtered Refiner's syrup —B— 0·28%

working up of the affination syrup, the final green and wash liquors and the final molasses do not contain as much amino acids as would be expected, considering the amounts of sugar which have been crystallized out from the original affination syrup. Some inversion takes place during the evaporation, and, because of the temperature used in boiling the massecuites, conditions are favourable for the condensation of some of the invert sugar with the amino acids, forming dark products containing nitrogen, as shown by STANEK.[1] Because of the extremely small quantities involved, it is practically impossible actually to demonstrate with the methods at present available that this is what has taken place. It is certain that the juices darken during the boiling, which fact, taken with the apparent disappearance of the amino acids, would indicate the plausibility of this explanation. The experiments with dextrose and amino acid mentioned throw no light on this phase of the question, because the temperature used was not high enough to bring about the dehydration of the first reaction product, which is capable of hydrolyzing back to the original amino acid, as proved by EULER and his co-workers.[2] Under the influence of higher temperatures the reversible condensation product

Flow Sheet 2.

Raw Sugar—0·025%

Limed and filtered through cloth

Filtered Liquor —C— 0·01% (Liquor was overlimed)
—D— 0·025%
—E— 0·027%
—F— 0·025%
—G— 0·026%

Char filter

Char-Filtered Liquor	Sweet-Water	Wash-Water to Sewer
—C— 0·003%	—C— 0·010%	—C— 0·25%
—D— 0·007%	—D— 0·014%	—D— 0·25%
—E— 0·008%	—E— 0·017%	——
—F— 0·005%	—F— 0·016%	——
—G— 0·005%	—G— 0·009%	——

undergoes further condensation or decomposition with the loss of water and carbon dioxide, forming brown amorphous substances,[3] from which the original amino acids cannot be regenerated by simple hydrolysis. Further investigation of this reaction and of the conditions favouring the second phase of it is necessary before the loss of amino acids during evaporation can be satisfactorily explained.

An interesting fact brought out by the results given in Flow Sheet 1 is that the amino acids are not present to any material extent within the crystals of sucrose. The raw sugar contained 0·025 per cent. nitrogen as amino acids, but the washed crystals contained only 0·0016 per cent (average), while the affination syrup contained 0·054 per cent. This could not be true unless the amino acids are concentrated in the surface films on the crystals, whence they are easily removed by washing. The small quantity remaining "in" the sugar is probably occluded in pockets between crystals surfaces which the wash-water does not reach. The concentration of substances containing nitrogen in the surface films should be taken into account in studies of the biological spoilage of sugar, as these nitrogenous compounds

[1] *Z. Zuckerind. Bohmen*, 1917, 41, 607, 618, 771. [2] *Loc. cit.*
[3] MAILLARD, *Ann. chim.*, 1916, 5, 258.

may serve as a source of nitrogen for bacteria and moulds. Furthermore, it clearly indicates that the composition of the surface film may be materially different from that of the crystal itself, even in the case of refined sugar. Confirmation of this has been deduced by SANDERA[1] from other lines of investigation.

While the method of analysis has been applied here only to the refining of cane sugar, there is no reason why it should not be applicable to the beet sugar process as well. It is hoped that the opportunity to test it in connection with beet sugar manufacture may be found.

Publications Received.

Control of the Sugarbeet Nematode by Crop Rotation. Gerald Thorne. Farmers' Bulletin, No. 1514; U.S. Department of Agriculture.

Contents: Distribution of the nematode, its life history, infestation, and host plants; general control methods (prevention of infestation, elimination of small infested areas, practical control by crop rotation and chemical agents); and the organization of control.[2]

Taschenatlas der Krankheiten der Zuckerrübe. Prof. Dr. Otto Appel. With 20 coloured plates by Aug. Dressel. (Paul Parey, Berlin.) 1927. Price: Rm. 5.

This small book consists of 20 very beautifully executed illustrations in colour of the commonest diseases of root and leaf to which the sugar beet is subject. Opposite each picture is some reading matter, describing the disease, and indicating the measures that may have been found effective in each case. It is an excellent little work, published at the suggestion of the Verein der deutschen Zuckerindustrie.

Étude Critique des Nouveaux Procédés de Rectification des Liquids Industriels. G. Mariller. (Chemie et Industrie, Paris.) 1927.

This is a reprint of a paper read before the 6th Congress of Industrial Chemistry,[3] which discusses: Apparatus for the dehydration of alcohol by glycerin, the direct method, and the new azeotropic process. It contains as a inset a pamphlet (in French) entitled "Controversy on Absolute Alcohol" between Messrs. MARILLER and GUINOT[4] dealing mainly with the consumption of steam in the different systems of producing absolute or high concentration alcohol, some of the points discussed having been raised by the former author in his recently published book.[5]

Chemical Engineering and Chemical Catalogue. Edited by D. M. Newitt, Ph.D., B.Sc., A.I.C. Third Edition. (Leonard Hill, London) 1927. Price: 15s.

This latest edition of the "Chemical Catalogue" is again larger than its predecessors,[6] which is evidence of the recognition of the value of the publication on the part of the industry. It now forms a very useful index of heavy and fine chemicals, raw material, machinery, plant and equipment, condensed and cross-indexed. Sugar, however, is still inadequately represented, and in the list of authors of technical and scientific books, which appear in this edition, the names of GEERLIGS and of NOËL DEERR do not appear.

The new sugar-house of the American S. R. Company at Brooklyn has a melting capacity of nearly 600 long tons per day; and its raw sugar store one of about 25,000 tons. Its boiler-house uses coal in pulverized form in furnaces that give results comparing favourably with those of most efficient municipal plants.

[1] *Z. Zuckerind. Czech. Rep.* (1927), 51, 237. [2] See also *I.S.J.*, 1927, 131.
[3] Also published in *Chemie et Industrie.* [4] Also published in the review *Agriculture et Industrie.*
[5] "Distillation et Rectification des Liquids Industriels," CHARLES MARILLER.(Dunod, Paris). 1925.
[6] See *I.S.J.*, 1925, 217; 1926, 324.

Correspondence.

PRODUCTION AND CONSUMPTION IN 1927-28.

To the Editor of The International Sugar Journal.

Sir,—We take the liberty of sending you a diagram showing the world's sugar production and the New York average sugar prices for the years 1886-87 to 1926-27.[1]

Up to 1914 we have gone by the statistical figures of Mr. F. O. Licht, Magdeburg. These only included some of the principal cane sugar countries. For the subsequent period (starting from 1900-01) we have taken the figures of Messrs. Lamborn & Co., New York, which include all countries of the world producing sugar. From these figures a conclusion may be drawn what the actual sugar consumption has probably amounted to during the period from 1886 to 1914. It is thereby shown that the yearly increase during this period has been 3·9 per cent. Had this rate of increase continued, the world's consumption would have reached about 30 million tons for the present campaign.

The diagram also shows that in 1921-22 the actual consumption had in consequence of the war remained about 6 million tons below what would otherwise have been the normal consumption and that since then consumption has increased at a yearly rate considerably above 3·9 per cent. This process of making up leeway is in our opinion still going on.

We wish to mention that this diagram was for the first time published by us in May 1925 on the occasion of the Magdeburg Sugar Exhibition, and since then we have been repeatedly requested to have it printed. In the issue of *Facts about Sugar* of Sept. 18th, 1926, a similar diagram was published by Mr. Camp of Havana, who added very interesting notes to it.

In comparing the trend of prices in each campaign with the difference between production and real consumption (as assumed by us) it is found that the figures assumed as consumption must be fairly correct because with very few exceptions prices rose when production remained below consumption and *vice versa*.

This is shown by the following table (the figures here and below represent million tons).

	The world's production.	Probable real consumption.	Production overlapping by	Consumption overlapping by	Prices dropped by	Prices rose by
1900-01	11·9	10·97	0·93	—	0·52	—
1901-02	13·0	11·40	1·60	—	0·50	—
1902-03	11·8	11·85	—	0·05	—	0·15
1903-04	12·2	12·32	—	0·12	—	0·62
1904-05	11·7	12·80	—	1·10	—	0·30
1905-06	13·9	13·31	0·59	—	0·59	—
1906-07	14·2	13·83	0·37	—	—	0·07
1907-08	13·6	14·38	—	0·78	—	0·32
1908-09	14·2	14·95	—	0·75	0·07	—
1909-10	14·6	15·54	—	0·94	—	0·18
1910-11	16·5	16·15	0·35	—	—	0·28*
1911-12	15·4	16·79	—	1·39	0·32	—
1912-13	18·2	17·45	0·75	—	0·58	—

[1] We regret that this diagram, which is in several colours, is too elaborate to allow us to reproduce it with the letter.—Ed. *I.S.J.*

* This rise is explained by the fact that a European drought (1911-12) was already apparent in July 1911.

Correspondence.

During recent years the ups and downs of prices have been so erratic that it is hardly possible to arrive at any conclusion what the real consumption has probably been. But in making an attempt at a guess we arrive at the following figures :

	Prices dropped by	Prices rose by	Production may have overlapped consumption by	Consumption may have overlapped production by.	The world's production was	The real consumption probably was
1921-22	0·19	—	0·40	—	18·6	18·2
1922-23	—	2·25	—	0·80	18·7	19·5
1923-24	1·08†	—	—	0·20	20·7	20·9
1924-25	1·61	—	2·30	—	24·6	22·3
1925-26	0·01‡	—	1·20	—	25·0	23·8

† Prices naturally reacted after an exceptional rise.
‡ Prices failed to react after an exceptional drop.

If this guess is correct, then the average increase of consumption has been at the rate of 7 per cent.

For comparison we add the figures of the "apparent" consumption as calculated from the world's visible stocks according to Messrs. Lamborn & Co.'s statistics :

1922-23	19·36
1923-24	19·85
1924-25	22·68
1925-26	24·31
1926-27 ....estimated	24·88

These calculations make us think that the actual consumption in 1927-28 will be very near 26½ million tons and probably the "apparent" consumption will be larger still because we shall enter the next campaign with reduced stocks (both visible and invisible).

As the production in 1926-27 according to Lamborn & Co. is estimated at 24·3 million tons, it follows that the world's production required in 1927-28 will have to show an increase of about two million tons to cover the real consumption.

Yours faithfully,

RUNGE, BACMEISTER, LAMBORN & Co.

Groningerstr. 14,
Hamburg,
July 5th, 1927.

The Commercial Solvents Corporation, with plants at Terre Haute, Ind., and Peroria, Ill., U.S.A., are offering synthetic methyl alcohol 99 per cent. pure in tank cars or drums, as made by them by a process patented and perfected by them.

Rum and sugar exported from French Guiana are now exempt from the 1 per cent. export tax which was instituted in 1925. The period of exemption is stated to be ten years.

The Hawaiian Commercial and Sugar Co., report a new record for the Island of Maui, T.H., of 15·45 tons of sugar (96° test basis) per acre for a field of 410 acres. Although larger yields have been stated for Oahu, this is a record for any single area of this size.

E. WARD, Jr., reports[1] that the average stand of roots in lands serving the Great Western Sugar Co., in Colorado, was 56 and 58 per 100 ft. of row for 1925 and 1926 respectively. In the latter season the average weight was 1⅛ lb., and the average yield nearly 13½ tons per acre, but a full stand of the same roots should have given nearly 18 tons per acre. Some farmers obtaining 100 per cent. stands (12 in. spacing) obtain in the district named 19·68 tons per acre, and the average weight of their beets was 1½ lbs.

[1] *Through the Leaves*, 1927, **15**, No. 5, 203-204.

Review of Current Technical Literature.[1]

LARGE CRYSTALLIZER CAPACITY NOT ESSENTIAL FOR OBTAINING LOW PURITY FINAL MOLASSES IN A RAW CANE SUGAR FACTORY. **Arnold H. Warren.** *Sugar News*, 1927, **8**, *No.* 6, 445-448.

Will the sugar crystallize out of solution from a massecuite sufficiently rapidly so that molasses of 40° gravity purity can be obtained at the moment the massecuite leaves the pan? The writer's answer, based on results obtained this past season, is that it will, his experience indicating that: (1) the apparent purity of the massecuite should not exceed 60, and should preferably be between 55 and 58°. (2) The grain should be small. About 1 litre of syrup of 65 Brix is drawn for graining for each 4 litres of massecuite to be produced. It is probable, however, that equally good results could be obtained with a larger grain provided the massecuite were boiled more slowly. (3) The apparent purity of the first molasses employed was below 50°. If first molasses of above 50 purity were employed it would be necessary to boil the massecuite more slowly to give time for the additional sugar to crystallize out. (4) The boiling of the low-grade strike should be carried on very slowly. No hard and fast rule can be given. The pan used was a calandria pan having about 1 sq. ft. of heating surface per cub. ft. of capacity. After the graining was finished and the drawing-in of molasses had been begun the steam pressure on the calandria was not at any time allowed to exceed 5 lbs. The time required to boil a strike was between 5 and 6 hours. (5) The Brix of the massecuite as discharged from the pan should be between 95·0 and 96°. (6) Care should be taken to avoid the formation of any false grain during the boiling, as this would make it extremely difficult to purge the massecuite without the use of water or steam. Slow boiling serves the double purpose of preventing the formation of false grain in the pan and of giving time for the maximum amount of crystallization to take place in the pan. If the molasses has already been reduced to 40° gravity purity, or thereabout, before the massecuite is discharged from the pan there is extremely little danger of the formation of false grain after the massecuite leaves the pan, no matter how fast it is cooled. During the period February 3rd to March 28th, 1927, the writer boiled a total of 24 low-grade strikes not one of which passed through a crystallizer. Each strike was dropped from the pan directly to the mixer above the centrifugals. Four strikes were allowed to stand in the mixer from 6 to 12 hours before drying was begun. The drying of the remaining 20 strikes was begun immediately after dropping into the mixer, on the average about 16 hours being required to dry each strike. Hence where drying was begun immediately the massecuite had an average of $16/2 = 8$ hours in which to cool during the process of drying. It is worthy of note that the mixer was not equipped with stirring paddles, as a result of which the cooling of the massecuite in the mixer was not uniform. Results obtained by the writer indicate that: (1) The gravity purity of the final molasses can be reduced to 40·0 without the use of crystallizers of any sort provided the boiling is properly done. (2) When dried hot the massecuite dries much faster than when dried cold, an important consideration when the low-grade centrifugal capacity is limited. (3) The polarization of the "B" sugar averages higher for massecuite dried hot than for massecuite dried cold. This means that the low-grade sugar can be worked up into 96° sugar with less pan work than is the case with "B" sugar of lower polarization. The writer does not wish to infer, however, that crystallizers are not a desirable part of the equipment of a modern raw sugar factory. There is no question but that a massecuite when cooled to a temperature 30° C. will yield a lower purity molasses than the same massecuite will yield when dried hot at a temperature of say between 60° and 65° C. A massecuite which when dried yields molasses of 40·0° gravity purity should if cooled to 30° C. yield molasses of between 33 and 37 gravity purity. A strike boiled by the writer in the same manner as those which he had been drying hot was dropped into cooling tanks holding about 35 cub. ft. each. These tanks were not equipped with any stirring device and crystallization doubtless did not take place as rapidly as where crys-

tallization in motion is practised. Nevertheless this massecuite when dried at the end of three days cooling yielded molasses of 34·75° gravity purity. The writer does believe, however, that the lack of what has, hitherto, been considered adequate crystallizer capacity cannot be considered a reasonable excuse for not getting the purity of the final molasses down to 40° C. He is of the opinion that with sufficient crystallizer capacity to permit cooling each strike a minimum of 24 hours, no difficulty should be experienced in keeping the gravity purity of the final molasses below 40° provided the boiling is properly done. Some European manufacturers of raw sugar factories provide much less crystallizer capacity than has been the American practice. A small factory of European manufacture may be provided with two vacuum pans and only two crystallizers, the total cubic capacity of the crystallizers being exactly the same as the total cubic capacity of the pans, but American practice favours a crystallizer capacity five times as great as the pan capacity.

NEED FOR REORGANIZATION OF CHEMICAL CONTROL IN CANE SUGAR FACTORIES IN CUBA AND THE DECLINE OF CHEMICAL CONTROL IN THAT COUNTRY. **Hayward G. Hill.** *The Planter*, 1927, **78**, *No.* 13, 247-248.

In the first part of his article the author deals with the quality of the raw sugar now being produced in Cuba, and indicates the importance of new methods of controlling it, in order to turn out a product acceptable to the refiner. It is probable that at this time of low profits more than at any time previous the refiner observes the fact that merely to buy a raw sugar on a basis of polarization is not sufficient protection to his interests, for two different lots of sugar, both fulfilling all requirements of polarization, might offer decidedly different refining qualities, the cost and time of refining one lot being much greater than the other. Naturally, the profits realized are in proportion. Ordinary methods of chemical analysis do not suffice to distinguish between these sugars, nor indicate in advance what the refining quality of a particular lot of sugar will be. But from recent publications of the Bureau of Chemistry, systematic investigations have been undertaken in which the ultramicroscope has been brought into use, in connexion with the basic dye test for the estimation of colloids. The application of this instrument and test brought out some remarkable facts. These investigations have proven[1] that practically without exception the refining qualities of a sugar can be positively predicted in advance by an estimation of the colloid content by means of this method. They have proven that a sugar having a dye value of 200-300 can be counted upon to be an easy and economical sugar to refine, whereas a sugar having a value of 300-400 will give medium results, and a sugar with a value of 400-500 or more will give trouble from the time it enters the refinery. It is plainly evident, then, that it would be an advantage to the refiner to choose such a sugar as will yield him the most profit with the least difficulty. He now has at his disposal the above-mentioned simple and accurate means whereby he can definitely decide what sugar will and what sugar will not meet these conditions. We do not hesitate to predict that if these conditions persist, before the 1927 grinding is over there will be companies in Cuba who will face a loss of many thousands of dollars because refiners will refuse to purchase their sugars. The way is now open whereby the manufacture may be conducted with direct reference to this point, by the installation of an ultra-microscope in connexion with the dye test. Thus, the course of the colloids may be traced throughout the fabrication, and the most efficient procedures for their elimination adopted, resulting in the ultimate improvement of the quality of the sugar, and an increase in profits to the company. Furthermore, this does not require a large outlay of capital. The apparatus necessary may be purchased for little more than $100. Another test which may readily be applied is that of the Elliott filter. This has been found to give useful comparative results as an indication of the refining qualities of raw sugars. And so we come to the point of what chemical control should do, and could do, but does not do.

Then the writer goes on to comment on the unsatisfactory state of chemical control in Cuba at the present time.[2] He has referred already to the fact that the

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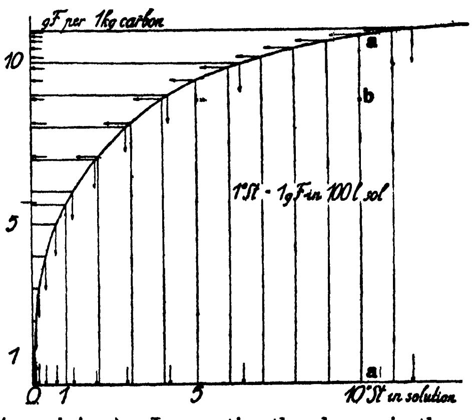
[1] *I.S.J.*, 1926, 23-28, 97-103, 137-140. [2] *I.S.J.*, 1926, 382.

custom of manipulating the figures in the laboratory to show a pretty loss account has in many cases changed the work of that department to merely a matter of clerical nature, thus nullifying the benefit that might be obtained from the accurate presentation of facts. This, furthermore, has discouraged any attempt at research on the part of the chemists, or any sincere effort to further co-ordinate the work of the laboratory to the manufacturing conditions practised, whereby the profits of the company on their investment might be ultimately increased. He has predicted that in a very few years a definite change is due which will establish a new relationship between the laboratory and the factory. The laboratory may be so equipped and organized as to render data and statements of great value, whereby the business may be conducted on a more profitable basis, or it may be used as a foolish, senseless sham to show fictitious fabrication reports of imaginary results and impossible balances. The time has come when the chemical control must be so reorganized as to permit the proper tests to be applied to show the quality of the sugar produced from the refiner's standpoint. If the quality of the sugar is not up to standard, the laboratory must be able to definitely indicate at what point in the process the difficulties are occurring. It is not improbable that in the future, included in the weekly manufacturing report issued by the laboratory, will be shown a statement or balance of the colloids, and the relative colloid content at various points in the process, as compared to previously adopted standards.

ESTIMATION OF THE VALUE OF ACTIVATED (DECOLORIZING) CARBONS. **Jaroslav Dedek.** *Sugar*, 1927, **29**, 255-256, 307-309.

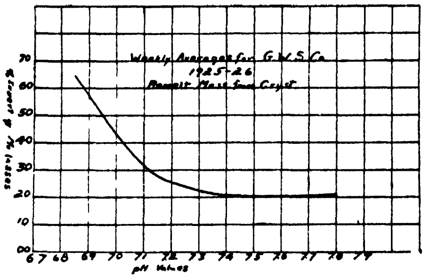
This paper is described as a simple explanation of adsorption in practice when using activated carbons, this phenomenon being defined as "the accumulation of a substance at the interface of two phases." The activity of an adsorbent depends on the quality of the surface (its degree of activation), the intensity factor, and on its area (its volume per unit of weight), the capacity factor, the total adsorption effect being given by their product, it being thus impossible to have two carbons of the same effect, due in one case to the surface area, and in the other to the high intensity. Adsorption from a mixture of substances, as in the case of impure sugar liquors, shows complicated conditions. Different solutes, for example, may compete for their places on the surface of the adsorbent, and mutually hinder their adsorption. Thus, a relatively smaller percentage of decolorization is observed with solutions of high concentration (e.g., syrups), as compared with those of low density (e.g., juices). In practice the change in the composition of the solution, due to its solutes being differently adsorbable, is of particular importance. On determining adsorption isotherms, quite abnormal forms are often found which can be explained only by the fact that a mere colour determination does not indicate the whole adsorption effect, the "invisible adsorption," that which cannot be determined by means of the colorimeter being in fact greater amd more important than the actual decoloration. Any influence depressing the solubility of a substance facilitates its adsorption, and vice versa. Sugar colours are present as salts of acids which themselves are differently soluble, the decolorization increasing, therefore, as the alkalinity decreases. An adsorbent will retain a higher weight of the solute per unit of weight the more concentrated it is, i.e., the nearer the point of saturation, complete adsorption from dilute solutions thus being most difficult. The adsorption equilibrium must take place between the concentration of the solute on the surface of the adsorbent and the concentration left in solution, which equilibrium can be represented



by the adsorption isotherm, having the values for the concentration of the solute left in solution after the adsorption (degrees Stammer) as abscissae, and the quantities retained by the carbon (in so-called Fusca degrees[1]) as the ordinates, as shown in the graph. This isotherm is constructed by decolorizing a solution with increasing quantities of carbon, and when found enables one to solve some questions, and elucidate the laws of adsorption. Thus, in the case of the graph herewith, to find the quantity of colouring matter retained by the carbon, when it has decolorized a solution to 10° Stammer, one finds the point of intersection of the curve with the line 10° Stammer (point *a*), while the distance (*aa*) shows the quantity of colouring matters retained, in this case, 10·825 grms. per kg. of carbon. When the solution had been decolorized to 5° Stammer one finds similarly the quantity of colouring matters the carbon can retain, viz. : 9·45 grms. per kg. only, that is, the carbon on contact with a dilute solution cannot retain as much of colouring matter as it does from a concentrated one. Examples of other questions that can be solved by reference to the isotherm are given.

WHAT IS THIS *pH* ? **J. H. Zisch.** *Sugar Press*; through *Sugar*, 1927, **29**, *No.* 5, 223.

"The laboratory like other departments tries to keep up with new developments which may be of value either in reducing costs or improving the quality of our final product. As a result of this policy the laboratory sheets will show a new figure this coming campaign, at least the figure will be new to most factories. The new control will be shown as "*pH* values" and it is hoped that it will take the place of and be an improvement over the old 'Alkalinity' control on the sugar end. At its present stage of development *pH* will probably not be used on first, second or third saturation, excepting for experimental purposes. It is hoped, however, to substitute *pH* for alkalinity from blow-ups on through the sugar end. Probably for general practical purposes it is sufficient to to say that *pH* is a more definite and accurate method of expressing alkalinity. The term 'alkalinity' is a measurement of the total amount of acid (or alkali) present with no consideration being given the fact that some of the acid is active and some inactive. *pH* is a system of numerically expressing the amount of active acid present. As it is only the active acid that affects the inversion of sugar solutions, it is evident that we should concern ourselves with such active acid rather than the active plus inactive as represented by the old term 'alkalinity.' Heretofore we have considered 0·00 alkalinity as being the so-called neutral point, but we now know that this does not always represent exact neutrality. The truth is that in most of our syrups, true neutrality is usually considerably on the so-called side of the old alkalinity scale, sometimes as low as — 0·050 to — 0·070. Due to the different chemical compositions of different liquors, we cannot say where the true neutral point is as represented by the alkalinity test, but we do know that true neutrality for all syrups will always have a *pH* value of 7·0. If the syrup shows a *pH* above 7·0, such as 7·5, the syrup is alkaline, if the *pH* is less than 7·0, such as 6·5, it is acid and there is danger of rapid inversion. Probably the lowest *pH* at which it is best to carry blow-up thick-juice and both raw and white massecuite is exactly 7·0, but until we have more comprehensive data on the subject it may be advisable not to allow the *pH* to go below 7·2. Some work was done at several of the factories during the past campaign in this regard, and the accompanying curve shows the danger of inversion of sugar when the *pH* of massecuite is allowed to drop below 7·0 to 7·2. A *pH* of 6·8 to 6·9 results in about three times as much inverted sugar as is found with a *pH* of 7·2. Not the least factor in Greeley's phenomenal run during the past campaign was the appli-



[1] *I.S.J.*, 1910, 84; 1921, 589.

cation of pH values in the control of the sugar end. The winner's yields and quality of sugar were undoubtedly benefited by the fact that pH control was depended upon instead of alkalinity. Several weeks' averages showed alkalinities of from —0·040 to —0·070 for raw massecuite, with practically no inversion of sugar, at least nothing abnormal, but the chemist was certain of his ground, because the pH values indicated an average of about 7·0. This new control is not an experiment, though new to the beet sugar industry, as it has been tried and proved in many other chemical industries including cane sugar manufacturing and refining, where large savings have resulted from its application."

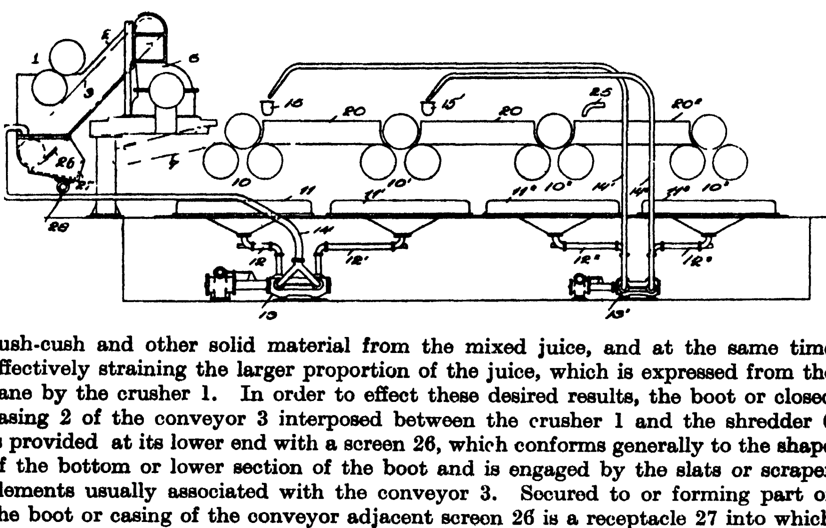
VARIOUS PAPERS ON LIME PROBLEMS IN THE STEFFEN DESACCHARIFICATION PROCESS. **R. W. Shafor, and others.** *Industrial and Engineering Chemistry*, 1927, **19**, No. 5, 573-576. This contribution to a symposium on lime by American chemists deals with the fundamental factors entering into the rate of decomposition of limestone lumps in kilns of the shaft type, this being done with emphasis on the transfer of heat. The experiments indicate that decomposition rates are controlled primarily by the rate of heat conduction through the calcium oxide layer on the face of a decomposing lump. A method is given for the evaluation of lime for use in the Steffen reaction to produce $CaO.C_{12}H_{22}O_{11}$. Other papers worth perusal are: "The Effect of Particle Size on the Hydration of Lime," by F. W. ADAMS; and "Rotary Kilns *vs.* Shaft Kilns for Lime Burning," by R. K. MEADE.—TECHNICAL STUDY OF THE DECOMPOSITION OF INVERT SUGAR BY LIME. **V. Ctyroky.** *Zeitsch. Zuckerind. Czechoslov.*, 1927, **51**, No. 24, 230-236. An apparatus was devised for study of the action of lime on invert sugar under the conditions prevailing in practice. It was found that the rate of decomposition depends firstly on the temperature, and secondly on the amount of lime. In practice almost the total invert sugar is destroyed during the time of contact of the juice with the milk-of-lime in defecation and carbonation, which time practically suffices for the complete decomposition of amounts of invert sugar as high as 1 per cent.—LUMINESCENCE OF SUGARS AND SUGAR FACTORY PRODUCTS. **K. Sandera.** *Zeitsch. Zuckerind. Czechoslov.*, 1927, **51**, No. 25, 237-245. Luminescence or fluorescence is exhibited by sugars and sugar factory products (in common with a number of other organic substances having the property of converting light of a certain wave-length into light of another usually greater wave-length). An apparatus has been devised for its quantitative measurement, the ultra-violet rays being screened off, and comparisons made with solutions of known luminescence. Pure sugar itself is hardly luminescent. In the case of impure products this quality is due, not to the ash, nor to the colouring matter, but rather to a colourless, or slightly coloured substance, soluble in ether and chloroform, apparently one of the first decomposition products of invert sugar destruction or of caramelization. Beet products exhibit luminescence in a much higher degree than the corresponding cane products.—INSOLUBLE MATTER IN LIQUORS USED FOR DECOLORIZING CARBON REFINING. **Siegfried Kühn.** *Zeitsch. Zuckerind. Czecho.*, 1927, **51**, No. 27, 271-272. Liquor taken directly from the blow-ups was found to contain 3·77 and 7·12 kg. of insoluble organic and inorganic matter per 1000 quintals of sugar melted in 24 hours, this pointing to the desirability of filtering before treating with decolorizing carbon, which does not appear always to be done. —STUDY OF THE INVERTASE IN SUGAR FACTORY WASTE WATERS. **C. Lad. Matousek.** *Zeitsch. Zuckerind. Czecho.*, 1927, **51**, No. 23, 213-220. Invertase, an enzyme which is present in diffusion waste waters, is a product of micro-organisms (bacteria, etc.), and to it is to be ascribed in part the increase in the invert sugar when using unpurified water for the extraction of the juice. Its amount varies according to the quality of the waste-water. With sound clean roots and the use of pure water no notable increase of invert sugar can be observed (it is seldom higher than 0·1 per cent.), but when using dirty water conditions are much less favourable. Laboratory tests showed the invertase present in waste-waters such as had been returned to the diffusion battery to be capable of forming invert sugar to the extent of 1·36 to 1·95 per cent. in 24 hours, in a 5 per cent. solution of sugar and at a temperature of 36° C. The main cause of the introduction of micro-organisms is the dirt on insufficiently washed roots, while the purification of the circulation water and the removal of sediment are also very important. J. P. O.

Review of Recent Patents.[1]

UNITED STATES.

Juice Straining System for Mills. **William G. Hall**, of Honolulu, T.H. (*A*) 1,627,283. May 3rd, 1927. (*B*) 1,727,284. May 3rd, 1927.

(*A*) A straining apparatus is provided, preferably located in the bottom of the boot of the conveyor between the crusher and the shredder, the clear juice being discharged into a receptacle, which in turn is connected by suitable piping for delivering the juice directly to the boiling-house. Referring to the drawing, 1 indicates a crusher for cane which is carried by an endless flight conveyor 3 to a shredder 6 whence it is delivered by conveyor 7 to the first unit 10 of the train. As indicated, there are four units 10, 10^1, 10^2 and 10^3, successively connected by intermediate conveyors 20, 20^1, and 20^2. Each of the units discharges into the pans 11, 11^1, 11^2 and 11^3, respectively; pans 11 and 11^1 below the first and second roller units are connected by discharge pipes 12 and 12^1 to the pump 13, which, in turn, is provided with a single discharge pipe 14. The pans 11^2 and 11^3, below the third and fourth mills, are connected by pipes 12^2 and 12^3 with the pump 13^1, which latter is provided with two discharge pipes, the first of which 14^1 discharges the juice into a maceration distributor 15 located above the first intermediate conveyor 20 and discharge pipe 14^2 delivers the juice into a similar maceration distributor 15^1 above the intermediate conveyor 20^1. A suitable water-distributing pipe 25 is located above the last intermediate conveyor 20^1 for supplying the necessary maceration to the bagasse on said conveyor. Mixed juice is ultimately received by pump 13 and delivered by discharge pipe 14 leading from said pump. It is the purpose of this invention to provide an effective straining device for removing the

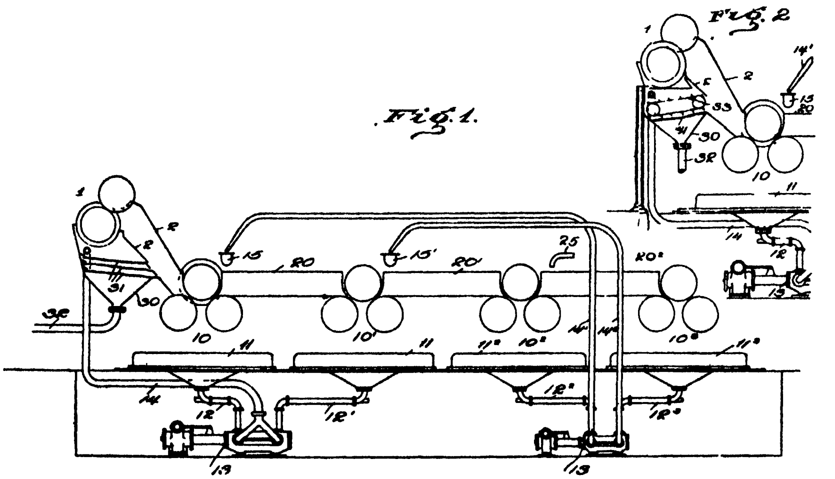


cush-cush and other solid material from the mixed juice, and at the same time effectively straining the larger proportion of the juice, which is expressed from the cane by the crusher 1. In order to effect these desired results, the boot or closed casing 2 of the conveyor 3 interposed between the crusher 1 and the shredder 6 is provided at its lower end with a screen 26, which conforms generally to the shape of the bottom or lower section of the boot and is engaged by the slats or scraper elements usually associated with the conveyor 3. Secured to or forming part of the boot or casing of the conveyor adjacent screen 26 is a receptacle 27 into which the juice passing through the screen is discharged, which receptacle is provided with an outlet 28 adapted to be connected with piping leading to the boiling-house. The discharge pipe 14 of the pump 13 is also connected with the lower end of the boot of the conveyor 3, and discharges the mixed juice directly into the lower end of the boot above the screen, so that all the juice (that extracted by the crusher 1 and the mixed juice from the several roller units of the mill) is discharged directly into the

[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom*: Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price 1s each). Abstracts of United Kingdom patents marked in our Review with a star (*) are reproduced from the *Illustrated Official Journal (Patents)*, with the permission of the Controller of H.M. Stationery Office, London. Sometimes only the drawing or drawings are so reproduced. *United States*: Commissioner of Patents, Washington, D.C. (price 10 cents each). *France*: L'Imprimerie Nationale, 87, rue Vieille, du Temple, Paris. *Germany*: Patentamt, Berlin, Germany.

boot of the conveyor 3 and passes freely through the screen 26, leaving the cush-cush, and other solid material on the screen, whence it is removed by the slats or scrapers of the conveyor flight, so that the openings in the screen are maintained free and unobstructed. All the strained juice passes directly into the chamber 27 whence it is delivered practically free from all solid matter by way of the discharge 28 to the boiling-house.

(*B*) A straining apparatus is provided, associated with the crusher or other equivalent preliminary unit of the mill, to receive the juice expressed by this unit and the mixed juice from the other mill units, the strainer device being associated with a receptacle to receive the juice from which the same may be pumped directly to the boiling-house. Referring to Fig. 1 of the drawings, 1 indicates a crusher, connected by a chute 2 with the first roller unit 10 of the mill. As illustrated, there are four roller units 10, 10^1, 10^2 and 10^3, each successively connected by intermediate conveyors 20^1, 20^2, and 20, serving to pass the bagasse from one mill to the next. Juice pans 11, 11^1. 11^2 and 11^3 are disposed below each of the corresponding mill units, the pans 11 and 11^2 being connected by discharge pipes 12 and 12^1 with a pump 13, the discharge of which is connected by a pipe 14 adapted to deliver the mixed juice from the several mills to the strainer device. The pans 11^2 and 11^3 are connected by pipes 12^2 and 12^3, respectively, to pump 13^1, which is provided with two discharge pipes 14^1 and 14^2, the former delivering the juice expressed by the third mill unit 10^1 to a distributor 15 disposed above the intermediate conveyor 20 between the first and second mill units, the juice so delivered



being then distributed over the bagasse on the conveyor as maceration. The discharge pipe 14^1 delivers the juice expressed by the final unit 10^3 of the mill and the maceration water delivered by pipe 25 to the bagasse on the intermediate conveyor 20^2, to a distributor 15^1 located above the intermediate conveyor 20^1 between the second and third roller units, the mixture of juice and water serving as maceration for the bagasse on said conveyor 20^1. By this distributing arrangement, all the mixed juice from the several roller units is ultimately delivered to the pump 13 and forced by the latter through pipe 14 to the strainer device. Located below and partially surrounding the lower roller of the crusher 1 is a receptacle 30 into which the large proportion of the juice expressed by the crusher passes directly, running down over the front of said roller, while the crushed cane passes down the inclined bottom 2^1 of the chute 2. The receptacle 30 is provided with a hopper-like bottom, above which is located one or more screens or strainers 31, which extend entirely across the receptacle, and are preferably provided with means for oscillating them to cause any solid material lodging upon them to be moved forward and discharged over the front edges of the screens into the chute 2. To facilitate the

discharge of the solid material lodging on the screens, the latter are preferably inclined toward the chute. The discharge pipe 14 from the pump 13 is connected to the receptacle 30 above the screens 31 therein, and serves to deliver the mixed juices from the roller mill units above the screens, so that the mixed juice from the several roller units, and the juice expressed by the crusher is effectively strained by the screens 31 and the entire body of juice discharged from the receptacle 30 by pipe 32 to the boiling-house, while the cush-cush carried by the mixed juice from the several roller units and the bits of cane, which may pass through the bottom 2^1 of the chute 2, are arrested by the screens and ultimately discharged from the surfaces of the latter into the chute, whence they are passed through the several roller units of the mill with the crushed cane. Fig. 2 (see above) shows a modification of the strainer device.

PRODUCTION OF SOFT SUGARS. **Henry C. Welle**, of Crockett, Cal., U.S.A. 1,624,296. April 12th, 1927.

In producing soft sugars it is found that they often have a dull, dirty appearance, the extent of this varying considerably. Even if originally produced with a fair colour, it frequently happens that a dark dirty colour is gradually developed on storage. It is the principal object of the present invention so to produce a soft sugar as to insure that it will acquire and maintain a desirable colour. Investigation has indicated that this difficulty with the colour is due to the presence of iron compounds, probably iron polyphenols, probably formed in the various operations in the refinery, though some of them may be present in the original raw sugars. As iron polyphenols are very dark in colour, a small quantity of them will greatly modify the appearance of the sugar. It is believed that the ferric forms are much darker than the ferrous forms, therefore the development of this dark colour on standing is believed to be due to oxidation. It has been found that by the use of solutions containing phosphate ions (that is, PO_4 anions) this dark colouring matter can be broken up. This is done by the application of solutions of phosphoric acid or phosphate salts, the iron polyphenols being decomposed with the precipitation of iron phosphate and the liberation of free polyphenols. While these possess a certain amount of colour, it is not objectionable—in fact is probably a desirable colouring matter to have in the sugar, the iron phosphate being light in colour and so producing no harmful effect on the colour of the sugar. But it is now claimed that in practice the phosphoric acid or phosphate salts may be applied in the centrifugals after the bulk of the adhering syrup has been spun off, or to the sugar after it has left the centrifugals. The actual application may be as follows : A solution is made containing 20 per cent. phosphoric acid, (H_3PO_4) or its P_2O_5 equivalent in acid calcium phosphate, acid sodium phosphate or other common phosphate salts (it being preferable to use them in the acid form). This is added to the centrifugal just before or just as it is being emptied, in such quantities as will give 0·02 to 0·2, say about 0·1, per cent. of H_3PO_4 on the weight of sugar in the centrifugal. If the material is added with a cup, it is thrown into the basket of the centrifugal just before the brake is applied. This results in a slight washing of a small portion of the sugar, but in being ploughed out and passing through the sugar scrolls the material is thoroughly mixed so that there is no evidence of washing of the sugar, and the entire mass of sugar becomes treated with the phosphoric acid. If the material is applied with a spray, it is preferable to apply it while the sugar is being ploughed out or in the scroll beneath the centrifugals. As an example, when 40 in. centrifugals holding 400 lbs. of sugar are used, 2 lbs. (say 1 qt.) of the prepared solution are thrown on the sugar just before the brake is applied to the centrifugal. If the centrifugal holds only 350 lbs. of sugar (as is the case with some grades) a smaller quantity of solution may be used, or the solution may be made more dilute—about 17·5 per cent. It will be found that the added water in the sugar does no harm for ordinary grades of sugar. After dropping out of the centrifugal the sugar is passed through scrolls that mix it thoroughly and then through an aerating device such as is commonly used for handling soft sugars. When the phosphoric acid is added it is found that there is a liberation of acetic and other

volatile acids, due to the presence of their salts in the sugar. If the sugar is thoroughly aerated while warm, these acids are practically all volatilized and the sugar becomes as alkaline or even more alkaline than before treatment. Claim is therefore made by the inventor for : The process of refining sugar which consists in adding small quantities of a solution containing phosphate ions to soft sugar after the surplus syrup has been removed, and thoroughly mixing the sugar and phosphate solution.

Production of an Absorbent Decolorizing Medium (Char, Carbon, etc.). Charles B. Davis, of New York. 1,618,149. February 15th, 1927.

In the prior state of the art of sugar refining, the carbon gradually deteriorates in its ash and colour-absorbing qualities until it becomes what is known technically as "discard," after which it is used for conversion chiefly into phosphoric acid and calcium sulphate. In this "discard" char the pores have either become clogged, or their surfaces coated with an inactive "secondary" carbon. Burning this "secondary" carbon with air at a red heat only weakens the skeleton of the base, causing it to powder without in any way reactivating the remaining carbon constituent. Other old methods are, treatment with alkali and acids, without any reactivating effect. But in the new process the impurities which go to form this inactive carbon are first removed from the porous base by cleaning by means of sodium hydrate and hydrochloric acid, thus getting rid of organic impurities and free mineral matter in their uncarbonized condition, and the original active carbon, which by use has become inactive, is reactivated to a degree equal to its initial activity. This process may be repeated continuously. On account of the extreme hardness of base thus attained, powdering by attrition is practically eliminated, and the little powder which may be formed is overbalanced by the new deposition of pyro-bituminous-oxygenated-carbon. In carrying out the process, the char, carbon, or other porous structural base, is washed with warm water and dilute sodium hydrate to remove organic impurities present or from the liquids treated; heated in water ; and 10 per cent. hydrochloric acid added until a slight permanent acidity is obtained ; after removing solubilized salts with hot water, the now neutral char, carbon, or other base structure, is dried and fumed with oxygenated pyro-bituminous-gas at the rate of about 1 part by weight to 1000 parts of base material, char, carbon, etc. The treated material is then heated out of contact with air to deposit what is believed to be a new unsaturated oxygenated-carbon ($C_{11}O$), and then cooled and used. After the carbon or other basic constituent loses its decolorizing activity, by adsorbing of impurities from the liquors treated, the process is repeated, and in this way even a discarded decolorizing material which has no further value as a purifying and decolorizing element is reactivated to such a degree as to equal the best new bonechar or other base, being restored to its original state. When new bonechar or base is given this treatment, its activity is increased enormously. $C_{11}O$ is therefore an unsaturated solid, and the only known "solid unsaturated monoxid of carbon," or "carbon in solid state carrying oxygen." As other means of getting oxygen gas, peroxide, perborates, permanganates, chlorates, metallic oxides, electrically produced oxygen, etc., may be used. In short, any substance which, whether heated or not, will evolve oxygen and communicate the same to the carbon, char, or other porous base to be treated. In fact any atmosphere, or metallic, or non-metallic element capable of supplying or evolving oxygen, in the cold or at elevated temperatures below 1000° C., and in neutral, alkaline or acid medium, with or without a reducing agent, which would in any of these ways communicate its gases to the carbon constituent, is to be regarded as being covered by this application. An additional advantage is that any excess of oxygen incidental for the production of this new oxygenated-carbon, goes to convert the calcium sulphide to sulphate, $CaS + 4O = CaSO_4$. Any calcium sulphide, CaS, taken up from these outside sources is split up into carbon oxysulphide COS, a gas, carbon monoxide CO also a gas, and calcium oxide a solid alkaline earth. Thus in preparing an absorbent base for decolorizing purposes, air, oxygen gas, or an oxygen-carrying or evolving material, is adsorbed on the microscopic capillaries of inorganic structures such as burnt-off lime phosphate, bones or bone ash, or

organic structures, as for example re-carbonized bones and carbon chars in general. In the presence of carbon or carbon-forming materials, the process produces a finely divided extremely hard and highly active oxygenated carbon sturcture which is the compound (C_nO) (carbon having active oxygen adsorbed on its surface) having an ash and colour adsorbing capacity superior to all known decolorizing carbons. By this process the carbon contains active oxygen adsorbed on its surface in a loose combined but essentially integral unitary state, and an enormously increased surface area is attained and rendered available for the absorption and removal of the impurities from the liquors to be treated, such as raw sugars in their process of refining. The permeability and adsorptive capacity of the carbon or char for the liquors is also increased over previous methods, permitting free access of the liquor to the innumerable open canals and passageways of the capillaries. The walls of the pores or capillaries of this oxygen-carrying carbon have greater tenacity and elasticity (on account of combination, with oxygen) and its susceptibility to temperature changes is practically nil, for the same reason, as it resembles vulcanite in its physical condition. Pyro-bituminous distillate may be "cracked" to an oily gas by heating and mixed with oxygen or air, and this mechanical mixture adsorbed on char or burnt-off bone and then heated, resulting in the C_nO compound before mentioned. In this way, the burnt-off bone is re-coated with carbon, and in either case the oxygen is retained in its active state on the carbon surface. These burnt-off bones have a high specific capacity or selectivity for the carbon forming "oxygenated pyro-bituminous gas." This pyro-bituminous substance is the distillate from coal, coming over between the temperatures ranging from 315 to 450° C. It is of a waxy consistency, yellow to brown in colour and leaves no coke in volatilization out of contact with air. This oxygenizing gas may also be mixed with char, forming materials such as colloidal "gels," and jellies of raw sugar gums. Ordinary bonechar saturated with air or oxygen also produces this new oxygenized-carbon (C_nO) : 60 litres of air or 0·2 lb. of potassium permanganate dissolved in 125 gallons of cold water and used as the last wash water will communicate its oxygen to the carbon and after washing out any soluble salts present, the char may be dried and used with or without heating, thus saving time and fuel. This demonstrated fact shows that the adsorbed oxygen gas produces the decolorizing and purifying results obtained, and that the oxygen is loosely combined on and with the carbon surface.

PURE SUGAR LIQUORS. **Carl F. Kullgren and Sven G. Lind,** of Stockholm, Sweden. 1,616,131. February 1st, 1927. Claim is made for the process for producing pure sugar liquors consisting therein that the sugar liquor is forced upwards from below through containers containing a layer or layers of a purifying means consisting of silicic acid, produced in the known way by treatment of an alkali silicate with an acid.—APPARATUS FOR DETERMINING H. I. C. **Eugene D. Stirlen,** of Muscatine, Iowa, U.S.A., 1,616,092. February 1st, 1927. Apparatus described consists of the combination of a double wedge prism, two receptacles for holding a portion of a sample under investigation, means whereby one beam of light may be caused to pass through one receptacle and the prism, and means whereby a second beam of light may be caused to pass through the other of said receptacles containing another portion of the sample mixed with a known quantity of a chemical substance adapted to react with the sample, thereby producing in said first mentioned beam a colour corresponding to a value which is being sought in the sample.—MANUFACTURE OF VEGETABLE CARBON.[1] **Leonard H. Bonnard** (assignor to **Alfred H. Bonnard,** of London). 1,619,649. March 1st, 1927. Hydrated magnesium carbonate is intimately incorporated into carbonaceous material of vegetable origin, the mixture heated to a temperature such that the hydrated magnesium carbonate is dehydrated and decarbonated with resultant production of a highly activated carbon containing magnesium oxide, and the product thereafter treated to remove magnesium oxide. —CANE STRIPPER. **John S. Warren,** of Sun, Miss., U.S.A. 1,628,087. May 10th, 1927. Claim is made for a cane stripper comprising a pair of arms each including a handle portion, a knife or cutter portion and a finger for directing the stripper into operative engagement with a stalk to be stripped, yieldable means

[1] See also U.K. Patent, 209,751 ; *I.S.J.*, 1923, 500.

connecting said arms together, said means permitting the arms to move towards and away from one another and also to move in a direction at right angles to their direction of movement towards and away from one another, and a pin or bolt secured rigidly to one of said arms and engaged loosely through an opening in the other of the arms, to hold them against movement in a direction at right angles to their direction of movement towards and away from one another, said pin being located adjacent to the knife or cutter portions of the arms whereby it serves as a stop to limit engaging movement of the stripper upon a stalk.—EXTRACTION OF CELLULOSE FROM BAGASSE. **Ernest C. H. Valet**, of Mexico City, U.S.A. 1,630,147. May 24th, 1927. A process for extracting the pure cellulose from the bagasse of sugar cane, consists in first treating the bagasse with a solution of 3 to 5 per cent. of lime, in boiling it afterwards under pressure in a solution of about 6 per cent. of caustic soda combined with a solution of 2 to 3 per cent. of sodium salts until all the foreign matter has been dissolved and separated from the cellulose, in cleaning the cellulose thus obtained with fresh steam after having drawn off the solutions, and in bleaching the pure cellulose. HEAT-EXCHANGE APPARATUS. **Aquilino R. Vila** (assignor to **Compania Cubana Economizadora de Combustible S. A.**, Havana, Cuba). . 1,630,148. May 24th, 1927. A heat exchange apparatus comprises a tank adapted to receive a supply of cold liquid to be heated, a tube heater longitudinally arranged throughout the lower part of the tank, a second tube heater arranged outside the tank, means for admitting a heating fluid to the space around the tubes of each heater, a pipe connecting the outlet from the tubes of first heater to the inlet to the tubes of the second heater, and a pump interposed between the tank and the first heater to cause the cold liquid from the tank to circulate first through the tubes of the heater inside the tank and then through the tubes of the heater outside the tank.—VERTICAL FILM-TYPE EVAPORATOR. **Leslie E. Sebald** (assignor to **The Griscom-Russell Co.**, of New York, U.S.A.). 1,631,162. June 7th, 1927. An evaporator comprising a plurality of heat transferring tubes, means for bringing a heating medium into heat exchanging relation with the exterior of the tubes, a liquid chamber adjacent the upper ends of said tubes, wherein a quantity of liquid is maintained submerging the said tube ends, vapour tubes concentric with said heating tubes and extending into the open ends thereof to thereby constitute an inlet passage for the water through the annular space between the outer wall of the vapour tube and the inner wall of the heating tube, means for automatically maintaining a substantially constant liquid level in said chamber to thereby insure a correspondingly constant rate of delivery of liquid to said heating tubes, said means including a float in said liquid chamber, a valve operated by said float, a collection chamber below said liquid chamber, connexions between said liquid chamber and said collection chamber, a variable speed pump in the connecting line between said collecting and said liquid chamber, and connexions between said float controlled valve and said pump, and means whereby the said constant liquid level may be controlled to occur at a desired height in the shell including a weight adjustably associated with said float to vary the submergence thereof.—BEET PULLER. **William Yermak**, of Danbury, Conn., U.S.A. 1,631,180. June 7th, 1927. A beet puller comprises a cross-beam, having a handle connecting means on one side thereof, beet engaging prongs on the other side, said prongs being formed with opposing loops adjacent the beam, and the free ends being spaced and slightly divergent, curved flanges on the prongs bent out of the plane of the same and extending from the loops to their ends, foot engaging teeth on the cross-beam adjacent the handle attaching means, all substantially as described.—MOLASSES PRODUCT. **Walter H. Dickerson** (assignor to **Industrial Waste Products Corporation**, of Dover, Del., U.S.A.). 1,631,252. June 7th, 1927. Claim is made for : A fertilizer obtained from refuse molasses and in the form of a powder consisting of dry, charred particles ; and a process of treating refuse molasses, which consists in spraying same into a gaseous medium of a temperature sufficient to char the particles thereof.—FILTER-AID. **Harry S. Thatcher** (assignor to **The Celite Co.**, of Los Angeles, Calif., U.S.A.). 1,632,458. June 14th, 1927. A filtering material comprises not more than 50 per cent. nor less than 15 per cent. by weight of particles which settle in distilled water at 20° C., at a rate of and greater than about 0·36 cm. per min.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs)	1927 Tons		1926 Tons.
Total Receipts, January 1st to July 27th	1,905,422	..	2,168,683
Deliveries " "	1,876,793	..	1,962,869
Melting by Refiners " "	1,857,698	..	1,914,000
Exports of Refined " "	55,000	..	60,000
Importers' Stocks, July 27th	143,491	..	214,470
Total Stocks, July 27th	215,403	..	317,617
	1926		1925
Total Consumption for twelve months	5,671,335	..	5,510,060

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1925, 1926, AND 1927.

(Tons of 2,240 lbs)	1925 Tons		1926 Tons		1927 Tons
Exports	3,063,394	..	2,489,408	..	2,238,221
Stocks	1,121,345	..	1,327,592	..	1,156,430
	4,184,739	..	3,817,000	..	3,394,651
Local Consumption	80,000	..	70,000	..	66,000
Receipts at Ports to June 30th	4,264,739	..	3,887,000	..	3,460,651

Havana, June 30th, 1927.

J. GUMA.—L. MEJER

Sugar Crops of the World.

(Willett & Gray's Estimates to July 7th, 1927.)

	1926-27 Tons		1925-26. Tons		1924-25. Tons.
CANE.					
America	8,305,309	....	8,665,210	....	8,877,329
Asia	6,246,948	....	6,309,189	....	5,661,027
Australasia	500,611	....	592,911	.. .	536,490
Africa	632,305	....	668,514	. .	545,260
Europe	7,500	....	8,704	....	7,661
Total Cane	15,692,673	....	16,244,528	....	15,627,767
BEET.					
Europe	6,843,590	....	7,440,367	....	7,083,068
U.S.A	801,246	....	804,439	....	974,185
Canada..............	28,000	....	32,475	....	36,200
Total Beet	7,672,836	....	8,277,281	....	8,093,453
TOTAL CANE AND BEET....	**23,365,509**		**24,521,809**		**23,721,220**

United Kingdom Monthly Sugar Report.

Our last report was dated 11th July, 1927.

There is little change in London prices during the month under review. The chief feature was the absorption of the London stock of white sugar, which has been a depressing factor in the market for over a year. The sound and recently landed sugars have rapidly disappeared, and in the absence of fresh imports the Trade had to fall back on the old landed stock. It is estimated that the stock of white granulated sugar in London that stood at about 60,000 tons on May 1st, is reduced to about 30,000 tons to-day, most of which is out of condition. This robs the market of sugar available for the liquidation of August terminal, and a solitary lot of 50 tons was the only tender which has so far appeared during the month.

A marked confidence is evidenced by August bulls as to the tightness of the position, while bears appear in little hurry to cover shorts, taking every advantage to liquidate their commitments as opportunity offers. The latest prices are, August 16s. 3¾d., October 14s. 11¼d., December 14s. 7½d., March 16s. 6d., May 16s. 8¼d.

In white sugar although the demand has not been excessive, prices have been well maintained, principally owing to the decline in the imports of white sugar to London, which since June 1st to date have only been 13,000 tons, compared with 45,000 tons in the corresponding period last year, and 50,000 tons for the year before. Spot granulated is nominally quoted at 29s. 9d., although it is scarce and well held. British refiners' prices also show an advance of 3d. per cwt. on the month. No. 1 Cubes 33s. 9d., and London granulated 30s. 10½d. Ready Dutch granulated has been changing hands at 17s. 1½d. f.o.b., and Czecho at 17s. 9d.

The Java Trust sold about 100,000 tons at prices ranging from 15¾ to 16½ guilders per 100 kg., and last week increased their estimate of the crop by 60,000 tons, making a total estimate of 2,300,000 tons for the Island. This had a quieting effect on the Java market. A fairly good business has been done to India from 14s. 9¾d. October/December and 14s. 11¼d. January/March, to 15s. 3d. and 15s. 6d. respectively.

Isolated parcels for London were transhipped to Hamburg and other ports on the Continent.

Raws have been easier, and several cargoes of Cubans for August have been sold at 12s. 6¾d. to 12s. 6d., San Domingos 96 per cent. are nominal at the same figure.

Movements in the New York "Futures" market show a decline of 17 to 14 points on the 1927 months, while March and May of next year are unchanged.

A feature of distinct interest during the month was the resuscitation by the largest Cuban and American sugar interests of the question of restricting the forthcoming crop. A proposal is on foot to advise President MACHARDO to limit the crop to 4,000,000 tons, only 3,500,000 of which would be available for export to the United States, the balance to be disposed of to other countries by a Corporatiom, which would be formed for the purpose. No decision in the matter, however, is expected until the Autumn.

Weather on the Continent continues favourable for the growing crop, and the condition of the roots is reported generally to be satisfactory.

21, Mincing Lane,
London, E.C. 3.
11th August, 1927.

ARTHUR B. HODGE,
Sugar Merchants and Brokers.

THE INTERNATIONAL SUGAR JOURNAL.

☞ All communications to be addressed to "The International Sugar Journal," 2, St Dunstan's Hill, London, E.C. 3.

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

No. 345. SEPTEMBER, 1927. VOL. XXIX.

Notes and Comments.

The Outlook.

The improvement in sugar prices as a consequence of the past season's crop restrictions in Cuba can hardly be considered up to anticipations. The market has continued to suffer from throes of depression and prices have only moved narrowly of late months. The leading question has been, what is Cuba going to do in respect to restricting her next crop? During the last few weeks there have been circumstantial reports that pressure was being put on the Cuban President by Cuban and American sugar interests to restrict the coming crop to four million tons only. This figure, or at the most 4½ million tons, is widely considered to be the restrictive limit to be decided on this Autumn by the President. In either case 3½ million tons would be earmarked for the U.S.A.

While we write these lines, cable despatches come to hand from Havana to the effect that an official statement has been issued announcing that a decision has been reached to recommend a law to the Cuban Congress limiting the future Cuban sugar production to a predetermined estimate of the world's market needs, based on the production and consumption statistics. The plan envisages the appointment of five experts to study the situation each year and recommend to the President the size of the crop that is to be authorized. This law would not, we take it, be passed in time to deal with the coming crop, and it seems probable that the President will himself decide it under his present mandate. But it is apparent that the intention is to exercise Government control indefinitely, in the hope that the wide fluctuations in the relation between world production and consumption which have ruled of late years may be cut down to a more economic basis. Cuba is is also credited with the intention of trying to secure co-operation from other big sugar producing countries in this endeavour. It is an ambitious and somewhat hazardous attempt, but its aim is on the right lines since the bane of the sugar industry in the past has been its subjectivity to wide price variations above and below the economic line, as a result of production not keeping in touch with consumption.

Labour Trouble in Queensland.

For some time past the extremer elements of labour in Queensland have been working for industrial trouble with a view to getting control of industry,

and just lately they have thrown down a challenge to the Government of that State (a Labour one by the way) which has brought on a first class crisis in the country, analogous only to the General Strike which was attempted in the United Kingdom in 1926 but so signally failed. Here too the question at issue is whether constitutional authority is to rule the country, or whether the trade union executives who would seem to be run by the extreme elements are to be the masters.

The trouble is not new, but it seems to have been brought to a head by certain developments at the South Johnstone sugar mill which was formerly a Government controlled mill, but was taken over by the growers last Spring. Our Australian sugar contemporary has so far refrained from summarizing the details of the dispute; but these developments were the other day summed up succinctly by a diplomatic correspondent of the *Morning Post*. The cane farmers originally accused the Government of mishandling the South Johnstone sugar central, which had been a continual source of labour unrest. The Government then invited the farmers to take over the control of the mill and these by a large majority last February decided so to do. The new control however led to friction with the labour unions, due, we understand, to the introduction of Italian labour (of which there is a plentiful supply in Queensland). The union labour went on strike, so the farmers organized themselves and started crushing on their own account. The Unions then induced the railway workers to declare the mill "black" and supplies to and sugar from the mill were held up in consequence. Furthermore, the handling of certain sugars at the ports has also been blacklisted, and various centres of transport have been subjected to hindrances at the dictation of one or other Worker's Union.

The last fortnight the Government have had to take up the challenge as the threat to transport generally on the railways and at the ports has assumed serious dimensions. The Premier, Mr. McCORMACK, has accordingly dismissed over 11,000 railway employes, but offers to take them back on his own terms. The Railway strike committee had actually declared the railways "black" till the South Johnstone dispute was settled; but the Premier pointed out that the merits of the sugar mill dispute were beside the question; the strikers at the sugar mill had twice rejected the settlement offered by the mill management and recommended by their own executive and the strike committee.

What the result of the challenge will prove to be must depend, as in the case of the abortive general strike in this country, on the extent to which Queensland opinion outside the labour unions will rally to the Government's side and by means of volunteer assistance keep the wheels of industry turning. There seems no doubt that the demands of the extremer elements of labour in Queensland of late years have been tending to put such obstacles in the way of the economic conduct of industry generally, that it was only a matter of a short time ere industry would have to take a definite stand and endeavour to break the incubus which threatened to take the control of industry from the hands of those responsible for the financial sinews of the country's activities and hand it over to the men's unions. Australia generally has been faced with troubles of this sort for years past and is hampered from the fact that the existing methods of dealing with industrial disputes are inimical to any decisive settlement of each crisis when it arises. The public at present would seem to have no option but to submit and suffer. Their position would appear to be summed up fairly by the following statement which we cull from the *Australian Sugar Journal*.

"Already the pinch of unemployment is biting severely into the peace of many a Queensland home. We have great industries shut down because of the obstacles placed in the way of economical working at a time when the State is reeling under the effects of long continued drought, and strenuous competition from all over the world. Employment even in Government services is reluctantly being reduced. Taxation has reached its utmost limits, and producers are at a disadvantage as compared with those in some of the other States of the Commonwealth. Thus, only the spirit of loyal co-operation and honest work on the part of both employer and employed can serve to lessen the intensity of the mischief ahead, or avert in any degree the depth of the misery which awaits those who with their families are dependent upon daily earnings. Most students of industrial matters have lost any faith they may have had in legislation as a means of ensuring peace between Labour and Capital. Too many of our 'blind leaders of the blind' are constantly preaching that such peace is neither possible nor desirable. But advocates of that view are the worst enemies of the community; for it is obvious that what is most needed in these perilous times is co-operation, not conflict; and that certainly is not being promoted by the methods which now have been 'on their trial' for the past ten or fifteen years. Surely the present happenings in Cairns, on the South Johnstone, and elsewhere are sufficient to justify an emphatic verdict of failure to meet the needs of the country."

The Mauritius Sugar Conference.

Largely on the initiation of Dr. TEMPANY, the Director of Agriculture in Mauritius, an important conference of the sugar industry was held in Mauritius last April, as a means of discussing points of importance relating to that industry and suggesting what improvements were desirable to bring it to a much more efficient state than has ruled in past years. A number of papers dealing with various aspects of the production of sugar cane and the manufacture of sugar therefrom were presented and discussed, and as a result a number of important resolutions were passed by a very representative assembly, which if carried out, as it seems likely they will be, should result in a very marked improvement in the economic status of the Mauritius sugar industry, and the qualities of the sugars turned out. The conference was in part private; but the resolutions passed have been published in the Mauritius press, and we are indebted to a translation in *Empire Production and Export,* which we summarize below.

Centralization.—It was agreed that Centralization must be carried out much further, if gradually, by means of the growth and perfecting of the principal factories, and that it would be facilitated by the voluntary formation of groups amongst the factories; it would only be, however, a more complete and better arranged development of a movement that has been going on naturally for many years. The present number of 44 factories is too many. But the process would have to be materially helped and encouraged by the Government in the form of a loan. This apart, factory owners who could should perfect their existing plant by means of more modern equipment.

Manufacture.—The Conference examined all the data bearing on the question of "white sugars" or "cargo sugars" and arrived at the conclusion that there is a greater advantage in manufacturing white sugars of good quality (type of Grade "A") than sugars of 96° polarization; every-

thing, however, should be done to produce a sugar satisfactory for the needs of the English market.

Sale of sugars.—The Conference decided that it was not desirable to alter the present method of selling Mauritius sugars, though at some future date the system might need to come up for reconsideration. Factory owners were recommended to produce the greatest possible quantity of sugars of a type suitable for direct consumption in England, and were advised to consider carefully the questions of packing, handling, and preserving their sugars so as to eliminate trade prejudices that have hitherto seriously interfered with the ready disposal of Mauritius sugars. A point was made of the necessity of uniform packing. Bags of sugar should weigh 80 kg. (176 lbs.) and not vary from bag to bag. Bags should be indelibly marked and a large number of differing marks should be avoided. There was also a great need to produce sugar with a much more uniform grain ; this might be difficult but it was a difficulty that must be surmounted at all costs.

Factory control.—The Conference also recommended improvements in the scientific control in the factories. This followed on the digesting of the technical reports submitted by various factory chemists in answer to questionnaires circulated amongst them.

Representation in London.—The Conference expressed the desire that Sir LOUIS SOUCHON, who has represented the Mauritius Chamber of Agriculture in London, should be accredited officially as the economic representative of the Colony in England, and so bring Mauritius into line with other Colonies already so represented. To aid the scheme it was suggested that a reserve fund should be set up by means of a cess of 2 sous per 50 kg. of sugar exported, which would raise about 100,000 rupees (say £7500) annually. This sum would not only defray the costs of the London representation, but also provide means of funding technical missions to large sugar centres in other parts of the world.

This is undoubtedly one of the most important decisions come to of late years by any of our British sugar producing regions and must augur well for the future of the sugar industry in that island. Mauritius before the war was content to jog along, providing sugars mainly for British India, whose quality standard was not high. The war led to her virtual introduction to European markets, but here the more exacting standards soon showed her sugar manufacturers that the placing of direct consumption sugars on the market was beset with difficulties unless these were of the highest quality. To her credit, Mauritius has preferred to experiment in the wholesale production of such sugars rather than confine her output to the more easily manufactured " cargo " sugars ; and the result of the conference has been to make her resolve to go on with this type of sugar and to so improve the manufacture that it will pass the rigorous tests of both the trade and the consumer. The other reforms if carried out will not only assist to achieve this desire, but will also lead to marked economies in the cost of production, so that in the end when the improvements have been carried out the Mauritius sugar industry should find itself in a strong and healthy position in the world's sugar markets.

What Mauritius needs to do.

As we remarked above, Mauritius " direct consumption " sugars though finding a market in this country have not hitherto met with unqualified approval because they have admittedly fallen short of our standard of what a direct consumption sugar should be. They have, it is true, been bought by the sugar-using trades, but a good deal has had to be re-melted

by the refiners before being placed on the consumption market. The standard set by the ultimate purchaser in this country, the housewife, is a high one, and the general run of Mauritius crystals so far offered has fallen short of this standard, so that sales have been restricted. It is encumbent, if the Mauritius manufacturers desire to take advantage of the benefits that the production of a higher grade of sugar should confer on them, that they should produce it consistently in such quality that it will compare favourably with the standard set in this country for table sugars, which by the way is reached without difficulty by the beet sugar factories at home. Only then can they gain the full benefit of their more modern mode of manufacture—a mode that promises sooner or later, with the advance of scientific methods, to supersede the older system of producing the consumption sugar in two stages at two factories thousands of miles apart. But this is a point that is being increasingly realized in Mauritius, and the impetus that the Conference promises to give to the venture should go a long way to achieve ultimate success.

The Suzuki Interests in Japan.

Mr. R. Renton Hind of the Manila *Sugar News* has recently been on a visit to Japan and in the July issue of his paper he gives briefly his impressions of the position in the Japanese sugar trade engendered by the financial failure of what he terms Japan's largest sugar brokerage establishment, Suzuki & Co. The general financial upheaval which has shown itself in that country the last few months has resulted in a number of business interests merging. Among these were the match interests, in which Suzuki was deeply committed. But a number of large sugar mergers which have been talked about are apparently not the result of necessity but largely opportunism. The other sugar companies are prosperous and doing well, and any combination amongst them would be a strong one. Chief amongst them is the Mitsui Bussan Kaisha, and indications, according to Mr. Hind, are that they have decided to make a strong bid for the position in the sugar industry formerly held by the Suzuki firm. If they succeed in securing control of Japan's sugar business a Sugar Trust may be created. Mitsui is supposed to represent the Imperial Government in business, so it is on the cards that the latter may be acquiring an interest in sugar.

There are also, we learn, rumours of further development in Formosa, where the Mitsui people have considerable interests. Japan desires to be self-supporting so far as sugar is concerned, and her growing population (which increases by a million annually) requires that more money be invested in her only tropical colony. The further extension of the Formosa sugar industry would then seem to be only a matter of time.

Historical Notes on Japan's Sugar Industry.

In the last number of the *Japan Sugar Trade Review* some interesting notes are given on the history of the sugar industry in Japan. According to these, the Japanese cannot claim for themselves the credit of first devising the method of manufacturing sugar, this having been already a discovery of the Cochin-Chinese, from whom the early Japanese learnt of the existence of sugar. It is on record that sugar was amongst the commodities imported from China in the 4th year of Tempei (A.D. 755) in the reign of the Emperor Koken, though there is no information as to the date of the first importation. Sugar cane not being indigenous to the soil of Japan was brought over from South China sometime in the period of Keicho, by an Oshima islander, named

Naokawa, who learnt not only of the cultivation of the cane in China, but also the method of manufacturing sugar from it. But for a long time Japan as a sugar producer remained in a state of infancy ; and parcels of black sugar or *shiroshita* were the only product that was brought from the Southern Islanders' factories to supply the market in Japan.

Thus for a long period Japanese consumers were supplied with nothing but low grade sugars, the native white or brown of Chinese merchants, no foreign refined being introduced. It was not till 1874 that Messrs. Jardine, Matheson & Co, brought into the country some Hong Kong refined which marked the first appearance in Japan of refined sugar manufactured by modern machinery. It was therefore at first termed " Machinery White " to contrast it with the Chinese Native White. Java sugar was first imported in 1876, Butterfield & Swire's refined in 1883, and German beet sugar in 1894. The Nihon Seito Kaisha Ltd. (Japan Sugar Refining Co.) was established in Osaka in 1897, this being the first refinery under Japanese operation. They started by melting Java raws and their product was an object of general curiosity amongst their customers. The new " central " system of sugar manufacture in Formosa was started after the Chino-Japanese War in 1894, when the Taiwan Seito Kaisha was established. In a dozen years the grinding capacity of this company increased from 300 tons to 36,900 tons ; and in 1925-26 it had its record crop of about 500,000 tons.

Sugar Sales in Japan under the New Duty Law.

According to the same Review, the revised Sugar Consumption Duty Law came into force in Japan on April 1st and new Formosan Head sugar appeared on the market at first 50 sen above the price of old muscovados, but the difference finally narrowed to 5 sen ; on May 16th spot muscovados were Y 18·65 per picul and Spot Head sugars duty paid, Y 18·70. Development in the consumption of the new sugar is very slow as compared with the old muscovados, because consumers do not know the true valuation of the new centrifugals and, moreover, they cannot afford to pay the higher price while a stock of the older sugar is available at lower prices.

During 1926 some 56,320 tons of Cuban sugar were imported into Japan and met with favour, being preferred to Java sugar owing to the larger size of the crystal. As showing the difference in price ruling in December 1926, between Formosan centrifugals and foreign sugars of less than No. 15 D.S., it may be mentioned that the average prices that month on the Osaka market per picul duty paid were : Formosa Centrifugals 19·66 Yen ; Java Raws, 18·04 Yen ; and Cuban Raws, 18·09 Yen.

The Louisiana Flood Damage.

As so often happens with catastrophes that attract world-wide attention, the earliest estimates of the damage done to the Louisiana sugar industry through the Mississippi floods fortunately proved unduly pessimistic, as later more carefully considered calculations have shown that the earlier reports exaggerated the extent of the destruction.

Official figures indicate that this season's crop was to have been about 23 per cent. less than last year's in acreage, that is some 147,650 acres as compared with 191,762 acres last year. The flood damage is now known to have involved at most some 34,000 acres, thus reducing the area under cane to 114,000 acres. But providentially for Louisiana out of this 34,000 acres on which the sugar cane has been destroyed by the floods, fully 32,500 acres were of the old varieties which would not have given any great yield :

only about 1500 acres out of the 23,500 planted with POJ cane were actually destroyed by the floods, and even on the lost area, unlike the native canes, the roots have not been killed and in every case a fine crop of suckers is being produced, which will furnish a large amount of seed for planting the coming Fall. On the assumption that it is desirable to replace the older varieties as soon as possible by the newer Java canes, the floods have really done the local sugar industry a good turn, since the 32,500 flooded acres above referred to will now be planted almost entirely with POJ canes. These last (we are told by a well-informed correspondent) are revealing a potential yield two or three times greater than that of the older canes under the same conditions. Of the rest of the cane standing, the D 74 is said to be doing well, but the sugar cane moth borer is again a threatening factor this season. Of the 114,000 acres under cane this year 82,000 will be used for sugar manufacture, 9000 acres for syrup, and 23,000 acres for seed. This last should with ordinary good fortune assist the industry to obtain in 1928 something like the acreage under cane that existed a few years ago; in 1924, for instance, a total of about 300,000 acres was under cane. Meantime, the sugar crop this year is estimated at about 90,000 tons.

Sugar in Italy.

During the 1926-27 campaign in Italy the total amount of sugar produced fell short of the consumption by some 50,000 tons. Raw sugar had accordingly to be imported for the refineries to melt and so supply the deficiency. But the import duty on raw sugar proved rather too high to enable the refiners to sell the sugar at the agreed price of 700 lire per 100 kg., so a Ministerial decree was issued reducing the import duty on raws from 384 to 332 lire per 100 kg. This alteration enabled the refiners to maintain prices at the customary level. As a precaution, however, the Minister of Finance has reserved the right to increase the duty again if it becomes apparent that circumstances allow the refiners to obtain excessive profits.

But prospects for the present beet campaign are more favourable for home production, even if earlier anticipations of the acreage that would be sown are not being realized. It is now expected that 95,000 hectares will be grown as against 80,000 last year; and hopes are expressed that once certain agricultural conditions which have hitherto hampered any larger extension of the sowings are overcome, no further importations of foreign sugar will be necessary.

The form of contract with the beet cultivators that was initiated last campaign gave good results, and has been renewed for the present season. Under the terms the cultivators receive 55 per cent. of the price paid for 100 kg. of sugar for every ton of roots with 14 per cent. sugar content; hereby any fluctuations in profit due to changing conditions of the money market are divided pretty fairly between manufacturers and growers.

The better conditions ruling in the sugar industry in Italy are well shown by the increased profits announced by various sugar companies. Dividends in many cases have been raised 50 or even 100 per cent. over previous distributions. The Industria Zuccheri, for instance, raised its dividend from 20 to 30 lire (presumably on 100 lire).

Erratum.

In the Table given on page 436 of our August issue showing the Per Capita Consumption of the Various Countries of the World, the dates were unfortunately omitted. The first two columns covered the year 1925-26, and the second two columns that of 1924-25.

Home Beet Sugar Notes.

The general results of the 1926-27 beet campaign in the United Kingdom, compared with the previous one, have been summarized by the Ministry of Agriculture in the following Table :—

	1926-27		1925-26
Acreage under sugar beet	129,463	..	56,243
Average yield per acre (tons)	8·63	..	7·67
Number of factories	14	..	9
Average number of days worked (England and Wales only)	114	..	87
Average number of workers employed in factories	7,194	..	4,613
Tonnage of beets delivered to factories	1,117,072	..	431,185
Average sugar content of beets (percentage)	17·31	..	16·36
Average price paid per ton of beet	59/5¾d.	..	55/6d.
Total production of sugar (cwt.)	3,069,739	..	1,035,672
Average extraction of sugar expressed as percentage of beets delivered to factories	13·83	..	12·01
Average farm output of sucrose per acre of beet grown (lb.)	3,346	..	2,809
Average factory output of commercial sugar per acre of beet grown (lb.)	2,656	..	2,063
Production of by-products :—			
Molasses (cwts)	715,886*	..	270,910
Pulp—Dry (tons)	62,800	..	21,795
„ Wet (tons)	26,138	..	31,481
Subsidy paid .—			
Sugar	£2,990,973	..	£1,009,019
Molasses	£317,892*	..	£112,562
Total	£3,308,865*	..	£1,121,581

* To 31st July, 1927·

It should be remembered that the factories have to pay excise duty on the sugar they produce at the rate of 7s. 4⅔d., per cwt. (98 per cent. polarization).

The production of dried beet pulp increased from 21,795 tons in 1925-26 to 62,700 tons in 1926-27, whilst the quantity of wet pulp fell from 31,481 tons to 26,138 tons. The quantity of dried beet pulp exported rose from 4657 tons in 1925-26 to 36,760 tons in 1926-27, being 21·4 per cent. and 58·6 per cent. respectively, of the total output in each year. Most of the pulp exported went to the U.S.A. where there would seem to be a ready market for this useful feeding stuff. In view of the heavy importation of feeding stuffs, it is unfortunate that farmers in Great Britain have not made more use of this very valuable by-product, rather than let it go out of the country.

During the summer protracted negotiations lasting two months took place between the Beet Sugar Factories Committee and the National Farmers Union with regard to the price to be paid under a three years' contract for beets delivered during the next (reduced) subsidy period, 1928-30. The present price basis is reckoned, as is known, on a 15½ per cent. sugar content in the roots. The price ruling till this season has been 54s. per ton plus 2s. 6d. for each additional 1 per cent. sugar content. In the negotiations for the new price basis, the factories first offered 44s. per ton at 16½ per cent. and 1s. 8d. for each additional 1 per cent.; but increased it afterwards to

45s. at 15½ per cent. with 3s. for every additional 1 per cent. The farmers first asked for 50s. at 15½ per cent. plus 3s. 4d. for extra content, but reduced their demand to 48s. at 15 per cent. plus 3s. 4d. Neither side could agree for the time being and a temporary deadlock occurred. But after an interval negotiations were resumed and finally an agreement was come to in August under which the factories undertook to pay a fixed guarantee price of 46s. per ton for beets of 15½ per cent. content plus an addition at the rate of 3s. for the first 1 per cent. above 15½ per cent. and 3s. 4d. for each extra 1 per cent. over that, the reduction in respect of beets below 15½ per cent. to be at the rate of 3s. for each 1 per cent.

The farmers have accepted the terms as the best they can secure, but individually there has been a good deal of grumbling which has been voiced in the district newspapers. The publication of the favourable factory balance sheets this summer has strengthened the belief that the factories could afford to pay more. Farmers point out that the cost of harvesting is over £4 per acre. However, the terms fixed are the best results that can be achieved by collective bargaining, and there is no doubt that they are better than any individual bargaining could have obtained.

Meanwhile, there is a steadily increasing acreage being put to beetroot in the United Kingdom. This season, according to Ministry of Agriculture reports, 221,700 acres are under cultivation, as compared with 125,800 in 1926 and 56,000 acres in 1925. As showing the important position now held by sugar beet in our agricultural rota, it is stated that its area is now half that of potatoes and nearly three-fourths that of mangolds.

Several new factory projects are under consideration. The principal one is in Herefordshire, where a company called the British Sugar Developments, Ltd., proposes to erect a beet sugar factory on the river Wye near Hereford. Much opposition is being evinced in the surrounding country at the proposal because it is feared that a sugar factory at work there would polute what is considered the finest salmon fishing river in England. Fishing interests have drawn attention to the fact that, as far as the labour question is concerned, the fishing rights and interests employ a large number of men annually, and their livelihood is jeopardized if the river is spoilt by the effluents from the proposed factory. On the other hand, Hereford itself and the surrounding agricultural community are anxious for the factory. An application has been made to the Government for a monetary loan to assist the scheme. The pollution problem is a very serious one, and its solution is already a matter of much experimental work. It may be noted, however, that any factory which causes pollution of a river comes within the law as laid down by the Salmon and Freshwater Fisheries Act of 1923, under which prosecutions can take place at the instance of fishery boards, while the factory is liable to actions at common law at the instigation of landowners and owners of fishing rights. It may be assumed, therefore, that the promoters of any such scheme will take steps to obviate the legal risk to which they are otherwise liable. As we go to press, they have issued a statement that the project will be abandoned if a successful method of neutralizing the effluent is not found ; but they say that out of a number of experiments tried they have found one which has so far proved successful and is being further tested. On the outcome of these tests will hang the final decision whether to proceed with the venture or not.

Other projected factory sites include Beccles in Suffolk, Hull, and Blunham in Bedfordshire.

The Cuban Sugar Crop.

(From our Havana Correspondent).

At the present moment the outlook for the coming crop is most uncertain, due, in the first instance, to the long period of dry weather through which the country is passing ; secondly, the uncertainty as to the continuation of output restrictions, and if placed, what the restricted crop will be ; and thirdly, the continued low price of sugar.

The drought.—The drought all over the island has been long and severe. Since the beginning of the year the rainfall has been just a little more than half that which fell the previous season, and that fact naturally means a short crop. In some favoured localities the cane is looking quite good, though behind last year in length of growth. Generally speaking, however, the cane is short, and unless good rains fall immediately, the average tonnage of cane per acre will be much under that of normal years.

The crop restriction.—The restriction of the crop is a subject that has caused, and continues to cause, a great deal of discussion in sugar circles, especially among the farmers (Colonos). While no one doubts the fact that the restricted output was instrumental in maintaining a better price for sugar last crop, many are doubtful as to whether the country as a whole has obtained benefits sufficient to cover the loss to the farmers through cane being left uncut. The farmers are very strong on this point, and maintain that while the restriction and consequential better prices have helped the Centrals, it has been of no benefit to them, and they would prefer harvesting all their cane at a slightly lower price, than have much of it left in the fields.

There is a great deal to be said for the farmer's point of view. He cultivates his canefields and spends money on that cultivation, and has therefore quite a considerable sum of money invested in them. He keeps up his cultivation as he expects to harvest all his cane, but just before the harvesting season, a crop restriction is put into force, and the farmer is prevented thereby from harvesting all the cane on which he has spent money in cultivation. Hence the farmer maintains with every reason, that unless he is enabled to harvest all his cane, what remains in his fields uncut represents so much money left in the fields, and is to him a serious loss. He therefore pleads to be allowed to harvest all his cane, even at a lower sugar price.

On the plantations of many factories the act of restriction will not be necessary because the long drought has decreased the cane tonnage so much that the cane supply for those factories will not be equal to the quota allowed them under the restriction decree.

Farmers' Associations have petitioned the President of Cuba, asking him not to restrict the crop. It is not known at the present moment what attitude the President will take up, but he stated some time ago that he would be guided by the wishes of the majority of the farmers. Nevertheless, we believe that the President will again decree a restriction on the coming crop. It has been the policy for the past two years, and the same policy, we believe, will be continued for another year. As mentioned above, the long drought has restricted the crop at many places, and restrictions by decree may not affect them. In other words, a restriction by decree might not be a necessity, but will be decreed as a declaration of policy.

As it is, rumour has it that the crop is to be further restricted to 4,000,000 tons. It is only a rumour so far, and must be accepted as such.

Cane and Beet Plantings in the Different Countries and a Comparison of their Sugar Yields per Unit of Surface.

By RUDOLF E. GROTKASS.

Tabulated statements on the acreage and yields of the sugar beet growing countries belong to the regular routine work of the sugar statistician, and are made available to the sugar trade at intervals from year to year. While these statements are given with a fair degree of accuracy, no information whatever is being published in the form of similar tabulated data for the cane growing regions. Hence some attempt is made in the following to bridge this gap as much as possible. This undertaking must be deemed no more than an attempt, since the sugar statistics of cane growing countries leave much to be desired in respect of completeness.

All the same, the totals obtained will permit conclusions to be drawn that are sufficiently clear to force us to revise some of the ideas on the superiority of cane against beet in respect to the sugar yield per unit of surface. As basis for the data concerning the beet, the campaign of 1913-14 is taken here, since it holds a record for beet sugar production that has not been re-attained since the war. For cane, the campaign of 1925-26 is taken as constituting also a high water mark in production. While figures for the former basis are readily available, those for the latter can only be collected with great difficulty, and represent in some cases no more than estimates. For Java, Hawaii, Porto Rico, Louisiana, and Peru the figures are exact; for British India, Cuba, San Domingo, Philippines, West Indies, Formosa, Australia, Argentina, Mauritius and South Africa their accuracy is somewhat less; while for Brazil, China, Mexico and most of the other small producing centres the precise figures can only be guessed.

The sugar yields have been calculated on the *planted* area, not on the *harvested* acreage as usually practised, both for beet and cane. Therefore changes have been made accordingly in the tabulation for the beet territories of Russia and the United States, as these countries lose regularly a certain amount of the plantings (10 per cent. and more) through the vicissitudes of their outstanding continental climate.

The calculation of sugar beet yields on harvested acreage alone leads to self-deception and should be discontinued.

As regards cane cultivation, the difference between harvested and planted surface represents in countries like Hawaii and Peru, for instance, on account of their two-year growing season, a proportion of 1 to 2. Again, Brazil and Australia have much longer growing periods than a year, and since the introduction of crop restriction in Cuba, some fields have been left unharvested until the next season.

The official Hawaiian sugar statistics furnish figures for the sugar yield per acre only on the harvested acreage, which is absolutely misleading since the surface taken under actual cane is fully double that acreage.

The total world sowings in sugar beets for 1913, with the exception of small areas in Switzerland, Australia and the Azores, thus reached 6,193,075 acres, or 2,507,318 hectares. The production in raw sugar value from this area yielded 9,013,000 metric tons. The world's beet sugar yield for 1913-14 per acre is therefore 1·46 tons, or 3·59 tons per hectare.

The total world plantings in sugar cane for 1925-26 thus furnish a figure of 11,891,285 acres or 4,808,352 hectares, the production in raw sugar values totalling 17,299,000 metric tons. The world's cane sugar yield for 1925-26, per acre, is therefore 1·45 tons or 3·57 tons per hectare.

I.—BEET SUGAR INDUSTRY, 1913-14.

Country.	Plantings in Acres.	Plantings in Hectares.	Raw Sugar Production. Metric Tons.	Raw Sugar Yield in Tons. Per Acre.	Raw Sugar Yield in Tons. Per Hectare.
Germany	1,316,122	532,843	2,715,870	2·06	5·10
Russia	1,807,373	731,730	1,740,466	0.96	2·35
Austria-Hungary	1,064,819	431,100	1,680,401	1·58	3·90
France	534,014	216,200	797,111	1·49	3·69
United States	629,035	254,670	739,859	1·18	2·90
Italy	203,400	82,348	329,940	1·62	4·01
Holland	152,646	61,800	231,413	1·52	3·74
Belgium	136,591	55,300	230,342	1·69	4·17
Spain	125,886	50,966	188,172	1·49	3·69
Denmark	76,076	30,800	143,800	1·89	4·67
Sweden	71,072	28,774	137,067	1·93	4·73
Rumania	32,145	13,014	38,620	1·21	2·97
Canada[1]	16,993	6,880	13,179	0·78	1·92
Bulgaria	11,708	4,740	8,670	0·74	1·83
Servia	11,115	4,500	5,600	0·50	1·25
United Kingdom	4,085	1,653	3,723	0·91	2·25

II.—CANE SUGAR INDUSTRY, 1925-26.

Country.	Plantings in Acres.	Plantings in Hectares.[2]	Raw Sugar Production Metric Tons.	Raw Sugar Yield in Tons. Per Acre.	Raw Sugar Yield in Tons. Per Hectare
Cuba	2,764,567	1,120,000	4,956,000	1·79	4·42
British India	2,679,000	1,100,000	3,157,000	1·18	2·87
Java	440,294	178,352	2,446,000	5·55	13·71
Brazil	1,480,000	600,000	904,000	0·61	1·51
Hawaii	237,774	96,000	720,000	3·03	7·50
Formosa and Japan	420,000	170,000	602,000	1·43	3·54
Porto Rico, St. Croix	308,750	125,000	558,000	1·80	4·50
Australia	247,000	100,000	526,000	2·13	5·26
Philippines	666,000	270,000	436,000	0·65	1·61
Argentina	346,000	140,000	396,000	1·14	2·83
San Domingo, Haiti	173,000	70,000	368,000	2·13	5·26
British West Indies, Demerara	200,000	80,000	322,000	1·61	4·05
Peru	148,200	60,000	270,000	1·82	4·50
China, Indo-China	370,000	150,000	252,000	0·68	1·68
Mauritius	173,000	70,000	241,000	1·39	3·44
Natal	247,000	100,000	218,000	0·88	2·18
Mexico	185,000	75,000	190,000	1·03	2·53
Louisiana and Texas	200,000	80,000	134,000	0·67	1·68
Central America	123,000	50,000	130,000	1·06	2·60
Egypt	64,200	26,000	94,000	1·46	3·62
Mozambique and other Africa	100,000	40,000	86,000	0·86	2·15
French West Indies	62,000	25,000	73,000	1·18	2·90
Fiji Islands	62,000	25,000	72.000	1·16	2·80
Other South America	100,000	40,000	68,000	0·68	1·70
Réunion	75,000	30,000	59,000	0·79	1·97
Surinam and Dutch Guiana	12,000	5,000	14,000	1·17	2·80
Spain	7,500	3,000	9,000	1·20	3·00

[1] For Canada the real figure for the sugar yield is somewhat better, since part of its beet crop is shipped to U.S. factories.

[2] With the exception of Java where absolutely reliable data are available, the calculation of areas has been effected in round figures.

As has already been remarked, some of the individual areas are estimates only, with an uncertain degree of accuracy, particularly Brazil and some others. Only some of the figures can be depended upon to the same degree as those of the European beet plantings. But in the absence of any better data they may serve as a basis to form an opinion. The total average obtained of the yields in the world's cane sugar industry ought, all the same, to represent pretty closely the true state of affairs.

The recapitulation of all the totals is as follows :—

Plantings Acres.	Plantings Hectares.	Sugar Production, Raw Sugar Value, Metric Tons.	Raw Sugar Yield in Tons. Per Acre.	Raw Sugar Yield in Tons. Per Hectare.
MAXIMUM BEET SUGAR PRODUCTION 1913-14.				
6,193,075	2,507,318	9,013,000	1·46	3·59
MAXIMUM CANE SUGAR PRODUCTION 1925-26.				
11,891,285	4,808,352	17,299,000	1·45	3·57

From these figures we must draw the surprising conclusion that there is at present no superiority of the sugar cane over the beet in sugar production per unit of surface. It is necessary, therefore, to revise our present opinions on this subject when discussing the latent more favourable conditions in the cane sugar industry. A glance at the different yields in the cane sugar producing countries shows extraordinary differences, which are very much greater than those found in the beet sugar territories ; from somewhat over half a ton for Brazil and the Philippines to 5½ tons for Java ; while for beet sugar (omitting the small producers) the differences range from about one ton for Russia to two tons for Germany.

This allows the conclusion to be drawn that the average sugar yield from the cane is capable of much greater improvement than that of the beet.

In the tabulation of these data stress has been placed to obtain figures for planted acreage only, not the harvested acreage that is usually calculated. The official data for the Hawaiian crop are regularly calculated on harvested acreage alone, giving for 1925-26 a figure of over six tons per acre, which is said to constitute a world's record. This is not the case. The growing season of cane in Hawaii lasts nearly twice as long as that in Java, extending fully over two growing seasons against one in Java. While the cane in Hawaii is still growing for another season and thereby still occupying the same field, another plant is simultaneously succeeding in rotation in Java. In the light of these facts, the sugar yield of 5·55 tons obtained in Java during 1925-26 constitutes the best performance hitherto reached in all countries. Germany which obtained, in 1913-14 2·06 tons per acre, had two years previously, in 1910-11, actually reached 2·19 tons. Comparing the results obtained in these two great representative producing centres of the world, with their figures of 5·55 and 2·19 tons (taking into consideration the length of their respective seasons, which is 14 months for Java, and six months only for Germany) the obvious conclusion presents itself *that in the physiological performance of sugar production by cane and beet respectively, on a given surface and during an equal length of time, no superiority of one or the other plant is noticeable.* Applying this axiom to the total world averages, the sugar cane is found actually to lag even considerably behind, due to reasons of a technical nature. Since there is no backwardness in agriculture and manufacture in Germany and Java, a comparison of the results of these two countries furnishes the best basis.

These aforementioned conclusions do not however permit us to speak of an economic equality in the conditions of the cane and beet growing territories of the world as a whole, since the cost of production, primarily of the raw material, and then the cost of the extraction process, together supply the decisive economic factor.

The European Beet Sugar Crop of 1926-27.

By H. C PRINSEN GEERLIGS, Ph.D.

The figures for the beet sowings in hectares and for the production of beet sugar in metric tons raw value, for the 1926-27 crop, as compared with those for 1925-26, are as follows :—

	1926-27		1925-26	
Country.	Hectares.	Tons	Hectares	Tons
Germany	373,561	1,654,752	372,542	1,593,315
Czecho-Slovakia	258,176	1,030,598	311,674	1,487,920
Austria	18,741	79,498	19,872	78,145
Hungary	62,500	175,000	65,513	166,286
France	228,020	703,502	214,300	746,913
Belgium	61,755	233,407	72,478	332,170
Netherlands ..	60,492	286,125	66,210	306,970
Denmark	29,500	155,000	37,679	182,000
Sweden	4,418	21,000	40,312	204,498
Poland	180,453	562,709	174,185	588,770
Italy	80,255	315,000	52,000	182,925
Spain	87,000	260,000	85,000	243,939
Russia	543,000	950,000	537,000	1,080,000
Great Britain ..	52,000	151,538	22,800	51,140
Other countries..	140,594	316,462	100,660	296,860
Total	2,180,465	6,894,591	2,172,225	7,541,851

At the date when the details of the sowings for the 1926-27 crop had to be fixed, the price of sugar on the world's market was a low one, New York quotations in January, 1926, being 2·37 cents and London ones 11s. 6d. This led growers in Continental countries, working for export, such as Czecho-Slovakia, Netherlands, and Belgium, to curtail considerably their sowings. In Denmark also a great decrease took place, while in Sweden the manufacturers bid so low for the roots that the associated beet growers refused to make contracts, so that in that country only 11 per cent. of the previous area could be planted.

On the other hand, in countries where production could easily be absorbed by consumption and where heavy import duties protected the producers against any competition of foreign sugar (such as Italy, Great Britain, and Russia), a considerable increase in the planted area was witnessed. The total area planted with beets remained about the same as in the year before, as is shown in the table given above. But the weather was not favourable, and on the whole a smaller output per hectare has been recorded, so that the total European sugar production fell off by 650,000 tons or 9 per cent. as compared with the year before.

Germany.—In Germany 251 factories have been active against 261 in 1925-26. The output of beets was 28,800 kgs. per hectare against 27,600 in 1925-26; and as the sugar content in 1926-27 was only slightly lower, the total sugar crop on approximately the same area was more by 61,000 tons, or 0·4 per cent.

The consumption, which had amounted to 1,429,250 tons, raw value, in 1925-26, was 1,213,400 tons in the first 10 months of 1926-27, equivalent to a 12 months' figure of 1,456,000 tons, or less than the production. For this reason the Committee handling the sugar exportation allowed an amount of 296,000 tons to be exported.

On the other hand, the raising of the import duty on 1st August from 10 to 15 marks per 100 kgs. of white sugar, or 13 marks per 100 kgs. of raw, accompanied by a decrease in the consumption tax from 21 to 10·50 marks per 100 kgs., caused an uncommonly large amount of foreign sugar to be imported, so that on 30th June the stocks were swollen from 514,984 tons in 1926 to 526,766 tons this year.

Czecho-Slovakia.—Since the sugar production of the Czecho-Slovakian Republic is so much in excess of the home consumption and consequently a large portion of the sugar produced has to be exported, the low price of sugar on the world market in 1926 led the sowings to be greatly reduced, as the following figures will show :—

	1925-26.		1926-27.
Bohemia	143,533	....	131,015
Moravia	93,577	....	83,715
Silesia......................	3,458	....	2,579
Slovakia.....................	71,106	....	44,913
Total	311,674	....	262,222

The sugar output underwent a great decrease, coming down from 1,487,920 tons in 1925-26 to 1,030,598 tons in 1926-27.

In the 10 months, September-June, Czecho-Slovakia consumed 305,124 tons of sugar, equivalent to 366,100 for the year, against a consumption in 1925-26 of 394,175 tons.

In that same period 652,658 tons, raw value, were exported, chiefly to Austria, Hamburg f.o.b., Great Britain, Fiume and India. But Switzerland, which up to now had been a regular customer of Czecho-Slovakian sugar, fell off as a consequence of the lowering of railway freights from other countries.

The position of the industry in this Republic is not favourable, as huge losses have been sustained by the drop in prices since December, 1926. The efforts to combine the sugar factories and refineries into a Kartell with a view to raising the home price in order to make good losses on foreign markets, have not as yet led to any agreement.

France.—According to official data France has sown 217,300 hectares with beets in 1925 and 228,020 in 1926. The production was 5,371,248 tons of beets in 1925 and 4,860,265 in 1926, or 24·742 and 21·316 kgs. of beets per hectare respectively. The output of sugar (raw value) amounted to 746,913 and 703,502 tons, or 3·438 and 3·086 kgs. to the hectare respectively. It follows from these figures that the campaign has not been a favourable one ; indeed it suffered severely from untoward weather. Consumption has been very low in 1926-27, amounting in the first 10 months to 671,774 tons (raw value) equivalent to 900,000 tons a year, against a consumption in 1925-26 of 992,106 tons.

France imported during September-May 258,439 tons of sugar, chiefly from her colonies in Africa and America, but also from Cuba, San Domingo, Java, Peru, Finland and Germany. She exported 150,905 tons of refined, principally to her dominions and protectorates on the North coast of Africa.

Belgium has produced 233,407 tons of sugar against 332,170 tons in 1925-26 and 399,972 in 1924-25. It imported during the first nine months of

1926-27 51,381 tons, exported 92,804, and consumed 131,368 tons. For the 12 months June-May, 1926-27, consumption amounted to 176,987 tons against 222,677 in 1925-26 and 193,604 in 1924-25. The sugar production per hectare of Belgium cannot be ascertained, since large amounts of beets have been exported to France and other quantities imported from the Netherlands.

Holland.—In the Netherlands 286,125 tons of sugar have been produced against 306,970 in 1925-26 and 329,244 in 1924-25. Over these quantities there was imported during the 10 months, September-June, 233,486 tons, chiefly raws from Java, Cuba, San Domingo, Peru, Mozambique, Poland, Belgium, etc., and exported 288,757 tons, principally as refined, with destination to Great Britain, Ireland, Turkey, Scandinavia, etc. The consumption during 10 months amounted to 191,305 tons in 1926-27 against 189,060 in the same months of 1925-26, and 183,106 in 1924-25, thus showing a steady slow increase.

Poland shows a slight drop in production, although the area planted had been increased. Latterly the home consumption of that country, which is free from restriction, has been increasing steadily, so that in the nine months, October-June, 1926-27, 251,700 tons have been consumed against 214,606 in the corresponding period of 1925-26. In that same period Poland exported 230,480 tons in 1926-27 against 263,319 in 1925-26.

Italy strives to render herself independent of foreign sugar supplies and has greatly extended her sowings from 52,000 hectares in 1925 to 80,255 in 1926. Still the production of 315,000 tons is inadequate to provide for the needs of the country, as in the 11 months, August-June, Italy has consumed 334,934 tons, equivalent to an annual consumption of 370,000 tons.

Russia is steadily increasing her sugar industry and hopes to regain its former significance. Year after year the planted area is extended, the sugar factories are remodelled, and already some sugar is being exported to Eastern countries. The figures given for the planted area and for the sugar output are as follows for the last five years :—

Year.	Hectares.	Tons.
1922-23	176,000	200,200
1923-24	247,000	360,000
1924-25	343,000	458,375
1925-26	537,000	1,050,000
1926-27	543,000	950,000

Great Britain.—Great Britain is the most conspicuous for its extension of the sugar production. During its years of existence the home output has been as follows :—

Year.	Tons.	Year.	Tons.
1922-23	7,011	1925-26	51,140
1923-24	13,280	1926-27	151,538
1924-25	23,750		

Other Countries.—Bulgaria, Yugo-Slavia, Rumania, Ireland, Finland, Switzerland come in for the balance of 316,162 tons in 1926-27, against 296,860 in 1925-26, but do not need special mention.

We may assess the total sugar consumption of Europe for 1926-27 at 8,350,000 tons and the exportation to Africa and Asia at 500,000 tons, thus necessitating an import of 2,000,000 tons of sugar from other parts of the world.

Criticisms of the Oxford Beet Dehydration Process.

Two papers on the beet dehydration process have recently been published in the German technical press. The first[1] is by Prof. Dr. H. CLAASSEN, a technologist of outstanding ability and experience, and writer of the well-known textbook, "Die Zucker-Fabrikation," and of many papers on various aspects of beet sugar manufacture, of whose authority to discuss matters on beet drying and juice clarification there can be no question. His contribution is a very pungent criticism of the work of Dr. B. J. OWEN, and his colleagues at the Institute of Agricultural Engineering, Eynsham Station. The second[2] is by Dr. INEO DE VECCHIS, whose name is well-known in connexion with the subject of beet drying[3]; but it is on less critical lines, being in the main a rather lengthy discussion in support of the general principles of his process.

DR. CLAASSEN'S CRITICISMS.

After remarking that nothing had come of the de Vecchis process in England following the hopeful newspaper announcements made regarding it, Dr. CLAASSEN draws attention to the work done by the Institute of Agricultural Engineering, Oxford, as reported by its Director, Dr. B. J. OWEN,[4] and goes on to make the following statements : Although this report does indeed contain detailed descriptions of plant for drying and extraction, it does not publish any experimental results. It would appear on the whole that the instigator of the experiments is not a chemist. In any case, he is not a sugar technologist having a sufficient knowledge of the nature and composition of the beet, and of the process of making sugar from it, seeing that the apparatus he recommends for the drying of the beet and its extraction is of such a construction that its unsuitability for the object in view would at once be realized by a competent sugar engineer.

For the desiccation of the sub-divided beet, the authors (B. J. OWEN, Director of the Institute mentioned, L. F. MANÈS, and J. L. DOUGAN) recommend belt dryers, stack dryers, and mass tray dryers, that is, apparatus which from the point of view of heat economy operates quite imperfectly, and, in respect of the quality of the dried material, offer no advantages over a good drum dryer. Contentions of the authors to the contrary are unsupported by experimental figures. Characteristic is it that such apparatus would be erected, not only in the factory, but also in the field, in order to economize in transport charges. How slices can be dried in the field, and what waste in fuel and labour would thus occur, can be left to the imagination of any sugar technologist without further comment.

Similar lack of knowledge is shown by the authors in their directions for the extraction of the dried beet and for the purification of the juices. They discover a continuously-operating extractor, consisting of a vertical worm in a cylinder, in which the beet slices are conveyed upwards, while the hot water for extraction falls from above in counter-current. Hence, whereas Austrian, French, and German inventors have racked their brains for more than 50 years without arriving at a generally satisfactory result, this apparently has been done by the authors in a few hours—at least on paper.

Yet more fantastic are the statements on the purification of the juices, which are first to be heated, and then eliminated from the impurities in centrifugal separators, after which they may be defecated by treatment with superphosphate or sulphurous acid, followed by treatment with dry

[1] *Centr. Zuckerind.*, 1927 35, No. 12, 331.
[2] *Ibid.*, 1927, 35, No. 31, 888-889.
[3] *I.S.J.*, 1924, 337, 447; 1926, 118.
[4] *I.S.J.*, 1927, 145-150.

tricalcium phosphate or calcium hydrate. By means of further additions of superphosphate or acid, the correct reaction is adjusted, and the juice filtered. Since no water is added, one should be able to obtain a very dense juice, capable of being directly concentrated in a vacuum pan, and thus boiled to grain. The authors concluded with the words that these methods of purification form a completely new process, which removes the difficulties hitherto encountered in the working up of the juice from dried roots. Evidence of this is held as superfluous.

Dr. de Vecchis' Remarks.

At the commencement of his rather lengthy article, Dr. de Vecchis expresses his entire agreement with what Dr. Claassen has to say regarding the "Oxford process," and then proceeds to discuss his own process : Fundamentally it is not new. Its peculiarity depends on the special conditions under which in the first stage of operations (which can hardly be termed the drying) the water originally present in the beet is almost completely eliminated, this leading to such an intense modification of the living cellulose of the plant that it is then possible to effect an easy separation of the sugar, no longer, however, by osmotic phenomena, but simply by an extraction with lukewarm water. Owing to its chemical characteristics, this dense juice is very different from that obtained by diffusion from fresh roots. It is also purer, and it can be worked up to the best direct consumption sugar in small, very simply constructed factories at smallest cost.

In order to arrive at good results, Dr. Claassen recommends the drum dryer, but Dr. de Vecchis has a different view, not so much on theoretical grounds, as because practical experiments have shown that this means of desiccating the sugar-rich slices cannot be employed under the necessary special conditions of his process. So that the drying shall proceed to its proper result without any alteration of the sugar, such as caramelization and invert sugar formation, it is necessary that the temperature shall be held within certain limits, not under 80-90° C., as only at these temperatures do the albumins and similar substances coagulate, later becoming horn-like, and not over 100-105° C., otherwise caramelization, and the decomposition of cellulose and other vegetable substances begin.

On the other hand, the desiccating operation must last a certain time, so that those physico-chemical processes upon which the de Vecchis process depends, may proceed and during this time the material must remain constantly at that temperature lying within the limits named. But with drum dryers according to the continuous-current, or even the counter-current principle (if the latter exists), it is not possible to hold the material undergoing drying at a certain temperature during the whole time.

Possibly this is only feasible with stack and still better with band dryers while returning the unsaturated hot air, utilizing the latter repeatedly, the desired temperature being meanwhile maintained. Work carried out during four years has established the conditions for the return of the air and the differences of temperature of the bands, and a dryer of suitable design was operated last campaign at Sanguinetto (Verona, Italy). It is clear that such apparatus is not suited for operation on the farm, as that in the "Oxford process," and cannot be operated by untrained workers.

In order to dry 1dz. (220·46 lbs.) of roots about 60,000 cals. are necessary (though this might be reduced considerably by utilizing the heat in the waste gases), which amount is equivalent to 4·5 to 5·0 per cent. of coal calculated on the roots, while for the further working-up another

4·5 to 5·0 per cent. would be required. This is a total of 9 to 10 per cent. of coal, which can be compared with 8 to 8·5 per cent. the consumption of coal in a well-conducted factory producing white sugar, or even with 12 to 13 per cent., the figure for many large factories at the present time.

Regarding the working up of the dried slices, Dr. DE VECCHIS remarks : Extraction is carried out in large open vessels or in smaller ones grouped together in a battery, and not in phantastic automatic apparatus working with screws. When the duration of extraction and the draw-off are correctly established, one obtains a " juice " of about 50° Brix, which after purification is directly drawn into the vacuum pan. Filtration of such juices (even when denser) can be done without difficulty, and the solid scum with the addition of a small amount of superphosphate to give it a grainy character provides a suitable filter-cake. At Sanguinetto during the coming season 2000 dz. (200 tons) will be worked up in 24 hours, and 100-120 dz. (10-12 tons) of refined sugar will be made daily in another part of the factory. Those interested, including Dr. CLAASSEN, are invited to inspect operations,

The Sugar Industry of the Soviet Union.

An Account of its Recent Resuscitation.

The following information on the sugar industry of Russia is from the pen of Dr. LEONTIEF, technical adviser to the U.S.S.R. Finance Commissariat at Berlin. It was translated from the original Russian by his Bureau and is offered to the sugar industry at large as the official report on the present condition of this industry in Russia. As such it may be taken as the most complete account that has appeared since the Russian revolution of the condition of sugar production in that country. We have slightly abridged the article, and have substituted English measurements in a few places.

Recent conditions ruling in the Russian sugar industry are typical of the entire economic development of the Soviet Union—in both cases we notice a serious increasing decline during the world and civil wars and a gradual improvement in the following years. The sugar industry is closely connected with South Russian agriculture. It was formerly dependent for its raw material to a greater extent on the big estates than on the peasantry. Consequently it was very severely affected by the agrarian revolution. However, the general economic revival of the last few years has found expression also in this branch of agriculture.

The chief features of sugar production before and after the war.—Within the present territory of the U.S.S.R. before the war 236 sugar factories were active. In 1914-15 the total production of these factories reached 1,710,113 tons of sugar and the average yearly sugar production during the five years preceding the war amounted to 1,490,000 tons. The Russian sugar production occupied the second place in the world ; it was second only to the sugar production of Germany, and its development was more rapid than that of other countries. Its technical basis reached a pretty high level. The enormous production of the Russian sugar industry in consequence of the prevailing prices and the low purchasing power of the peasantry, did not meet with a sufficient demand in the home market (the annual consumption averaged 17·4 lbs. per head of the population, thus remaining considerably below the consumption of Western Europe). As a result, a considerable amount of the sugar produced used to be exported.

During the war and the subsequent revolution, the sugar industry decreased both quantitatively and qualitatively; its organization and especially the supply of raw materials were entirely remodelled in consequence of the nationalization of the factories and the big estates.

The position of the sugar industry during the war and the last few years is to be seen from the following table :—

Year (Season)	Number of Factories Working.	Cultivated Area under Sugar Beets, Hectares	Amount of Sugar Beets Used, Metric Tons	Sugar Output, in Tons	Average Sugar Output per Factory, in Tons
1914-15	237	724,400	12,141,000	1,710,110	7220
1917-18	229	571,900	6,895,100	915,160	3990
1918-19	209	393,600	2,770,700	333,230	1590
1921-22	112	116,900	405,300	50,770	450
1922-23	121	169,600	1,740,300	209,420	1730
1923-24	122	258,300	2,837,300	377,140	3090
1924-25	124	324,100	3,254,200	455,390	3670
1925-26	143	531,300	8,104,800	1,061,140	7370
1926-27	166	531,600	6,123,900	873,420	5200

As shown in the above table, after the outbreak of the war the output of the sugar industry commenced to decrease; during the civil war this decline was accentuated, and apart from that, unfavourable weather conditions also severely affected the industry. Thus the production of the sugar industry in 1921-22 reached only 50,770 tons, i.e., only 3 per cent. of the production of 1914-15.

This decrease of production was caused partly by factors lying within the sphere of supply of raw materials and partly within the sphere of production as such. At that period we find a great decrease of the cultivated area under sugar beets, the loss of crops and a decrease in the yield of sugar beets. In the process of production we notice an inadequate utilization of the raw materials and a decrease of the rate of productivity. Apart from the factors affecting mainly the sugar industry there were many other factors of a general character which also influenced the sugar production, such as: the diminishing supply of auxiliary materials, the lack of fuel, the decrease of the productivity of labour, etc.

The reconstruction of the sugar industry.—In 1922-23 commences the reconstruction of the sugar industry which was combined in a state trust (Sugar Trust) and subordinated to the Supreme Economic Council of the U.S.S.R.—the central body for the management of the industry of the U.S.S.R. The above table presents the process of reconstruction and the achievements already obtained. It is essential to bear in mind the fact that in the Soviet Union the reconstruction of the sugar industry began three years later than in Western Europe.

After the nationalization of industry and under the new agrarian conditions measures were taken first of all to increase the cultivation of sugar beets and to improve the methods of work of the peasantry, and further to organize and concentrate production in a reduced number of well equipped factories. The dependence of the sugar factories on the proximity of the sugar beet area increased the difficulties of this task. However as a result of the measures adopted the work of the factories became more amd more productive and economical. The output of 1925-26 reached 60 per cent. of the record production of 1914-15 and 72 per cent. of the average yearly output of the pre-war time. In 1925-26 when the harvest of sugar beets was good, the pre-war rate of utilization was attained by a number of factories and in some cases it was even superseded. Nevertheless a comparison

of the output of the two years 1925-26 and 1926-27 shows a decrease of the sugar production. This is, however, due entirely to the bad harvest of sugar beets in the latter year. From the point of view of quality progress was made also in the current year.

Cultivation of sugar beets.—The cultivated area under sugar beets in 1926-27 amounted to 531,596 hectares, that is to say it trebled within the last five years. However within the last two years its growth has somewhat slackened. In 1925-26 the growth of the cultivated area was unproportionately big (from 324,100 to 531,300 hectares) and the new area had to be stabilized. Apart from that, all the technical crops were unfavourably affected by the relatively low prices of these products as compared with the prices of grain.

These causes, were, however, not of a permanent character. According to preliminary figures of the Sugar Trust the cultivated area under sugar beets in the current year has already reached 670,000 hectares, which means an increase of about 25 per cent. as against the previous year.

The changes in the agrarian conditions referred to above found expression in the following phenomena : In the last year before the war the peasantry possessed 14 per cent. of the area under sugar beets while the big estates and the sugar factories held 86 per cent. At present the peasantry holds more than two-thirds of the entire area ; only about one-third is in the hands of the national sugar factories. The latter produce also the entire amount of seed for the peasant estates. The adoption of the cultivation of sugar beets by the peasantry forms the basis for the economic progress of the peasant estates. Before the war the peasantry cultivated only 150,000 to 160,000 hectares, in the current year their quota is about 450,000 hectares, i.e., about three times that amount. The Soviet Union possesses enormous areas of fertile land which is well adapted to sugar beet culture in view of its climatic conditions and the quality of the soil. Therefore the sugar industry of the Soviet Union has good prospects for its future development. The wide area of " black earth " in the Soviet Union is suitable for intensive sugar beet culture even without a large expenditure on manuring, and since there is sufficient labour available in agricultural districts, these crops can be raised without fear of competition of other countries.

Production and consumption of sugar.—The sale of sugar in the U.S.S.R. in the last three years, as compared with 1913, was as follows :—

Year.	Sale in Tons.	Consumption per Head in lbs.
1913	1,300,000	17·4
1923-24	397,900	6·4
1924-25	663,400	10·3
1925-26	875,000	13·6

The consumption of sugar has grown very rapidly. Already in 1925-26 80 per cent. of the pre-war rate had been reached. The output of sugar in the first years of reconstruction did not suffice to satisfy the demand, consequently an import of sugar became necessary. In 1925-26 the sugar output not only sufficed to supply the demand of the home market, but there was even a surplus left. In 1925-26 the output amounted to 1,064,700 tons, which together with the rest remaining from the import of the previous year make a total amount of 1,130,100 tons. In the same year the sale in the home market amounted to 917,200 tons, and the export to 24,500 tons ; thus at the beginning of 1926-27 the surplus remaining amounted to 188,400 tons. The output of 1926-27 reached 851,800 tons, which together with the

surplus of the previous year makes a total of 1,040,100 tons. This will suffice to cover the home demand and will leave a surplus for export.

Exports of sugar.—Before the war the Russian sugar export did not present an even line of development. The average yearly export during the last five years preceding the war amounted to 191,800 tons of raw sugar and 73,800 tons of refined. The chief buyers of raws were England (38·5 per cent.), Finland (27·3 per cent.), and Turkey (19·6 per cent.), then followed Germany (6·7 per cent.) and Persia (6·0 per cent.). The chief buyer of refined was Persia (77·8 per cent.).

The present export differs considerably both in its character and destination from the pre-war export. To-day, the sugar export will go chiefly to the East. Amongst the oriental markets it is in the first place northern Persia that is attracting the attention of the Soviet Union. The Persian market is now playing the same important part for the U.S.S.R. as it did before the war. Amongst the other eastern markets the neighbouring states of Afghanistan, Mongolia, Turkish Turkestan, are all of importance, as they are not producing sugar themselves and already are importing it in lesser quantities from the Soviet Union.

Somewhat more limited are the possibilities of export offering in the West—first of all to the Baltic States. The total sugar export of the U.S.S.R. in 1925-26 amounted to 40,900 tons. In 1926-27 the amount of sugar to be exported is estimated at 122,900 tons. However it has to be taken into consideration that the world demand for sugar, which since the war has greatly increased, will soon swallow the surplus of the world's sugar production, and thus new perspectives for the further development of this industry will be opened.

Thus we see that the sugar industry of the Soviet Union, working under new conditions created by the revolution, has proved perfectly able to cope with the problems of reconstruction and it sees wide perspectives of further development in front of it. The home market is as yet far from being satisfied. Considering that it is intended to reduce the price of sugar to its pre-war level it seems quite possible—in view of the undoubtedly rising purchasing power of the population—that within the next five years the home sale will reach 1,640,000 tons as is estimated. The promotion of sugar consumption is regarded as an antidote to the consumption of spirits.

The condition of the sugar factories.—Let us now analyse in short the position of the sugar factories and the original capital at the disposal of the Sugar Trust as well as the capital expenditure for reconstruction and development of this industry.

According to the balance sheet of January 1st, 1926, the ordinary capital of the Sugar Trust at its present value, after due deductions for wear and tear, amounted to 385 million roubles. However these properties are to such an extent out of repair that reconstruction work immediately assumes such dimensions that we may speak of complete renewal, through which technical progress is facilitated. To the original capital of the Sugar Trust has to be added about 1 million hectares of land, out of which 800,000 are suitable for cultivation of sugar beets. There is no present valuation of this land. Before the war its value amounted to about 350 million roubles.

Within the present territory of the U.S.S.R. there were once 236 working sugar factories, out of which 199 are in existence, though not all of them are working. In 1926-27 169 factories were in operation; of these 151 are being exploited by the Sugar Trust, 15 by lease holders, and two form part of local state industrial enterprises. The remaining 30 factories are in reserve—

they are the smallest, technically least efficient and most unfavourably situated factories. Out of these 30 factories 22 are to be completely liquidated and eight will be re-equipped.

The total productive capacity of the sugar factories at present amounts to about 88 per cent. of their pre-war capacity. Apart from that, within the present territory of the U.S.S.R. there were before the war 37 independent sugar refineries and 14 refining branches in various sugar factories. These latter and 35 of the former have remained intact up till the present moment. From a technical point of view they are all in a satisfactory condition.

Investment of capital and formation of prices.—The investment of capital in the sugar industry of the U.S.S.R. during the last years finds expression in the following figures : 1924, 20 million roubles ; 1925, 41 million roubles ; 1926, 28·6 million roubles ; 1927, 23·3 million roubles.

These investments were applied for the purposes of enlargements, new equipments, for the supplementing of the outfit of working factories, and for the building of houses for the workers. The building of new factories will begin in 1928. Out of 55 million roubles which are to be expended for this purpose, in that year eight million roubles will be spent on the erection of new buildings. The new factories will replace the obsolete and unprofitable ones that are to be liquidated, as their further employment is not expedient in view of the large expenditure required for their re-equipment.

The latest version of the programme for the erection of new factories in the next few years foresees the following : In 1927 two factories will be newly equipped and put into operation ; in 1928 seven factories will be taken out of the reserve and the building of six new factories will be begun—they will start work in 1929. Further, in 1929 the building of another six factories will be commenced and in 1930 another five will follow. Altogether out of the existing 199 factories 22 will be liquidated, 71 enlarged through partial rebuilding, 15 entirely newly-equipped, and in place of the 22 liquidated ones 17 new factories will be built. Thus in 1930 194 factories will be in operation. The carrying out of this programme of reconstruction of the sugar industry will begin in the next year.

The measures foreseen in this programme are by no means finally fixed, as it was worked out under the pressure of the present financial difficulties. Any lessening of this pressure will automatically lead to an increase of the building activities. Generally, during the period of 1928-30, new investments of capital in the sugar industry, amounting to 212 million roubles, will be made, the largest part of which is to be used for productive purposes—for the building of factories, their outfit and equipment. These investments will be covered out of the reserves of the sugar industry itself. They will tend to increase the total productive capacity and to reduce the cost of production. The average daily capacity per factory will amount to :—

	Tons.			
	1927.	1928.	1929.	1930.
In the old factories	503	512	539	562
In the new factories	—	—	985	985

The productive capacity of the new factories will be considerably higher than that of the old ones.

As regards the price of sugar this is being successfully regulated by the competent authorities. During the last two years the price of raw sugar remained almost stationary at 8·80 roubles per pood (about $13·50 per 50 kg.) free works. In these prices are included 4 roubles of excise duties.

Recent Work in Sugar Cane Agriculture.

THE TUCUMAN AGRICULTURAL EXPERIMENT STATION IN ITS RELATION TO THE ARGENTINE SUGAR INDUSTRY. **A. H. Rosenfeld.** *Tropical Plant Research Foundation. Scientific Contributions, No.* 7, 1927.

This Station bids fair to take the place of an Agricultural Department for a large part of northern Argentina, for its sphere of operations is by no means confined to the sugar industry—a fact that must always be borne in mind when surveying the work on this crop, and explaining a certain amount of simplicity in the various projects undertaken. The time will surely come when Argentina will fall into line with other progressive sugar countries and have its own set of one-crop officers whose whole time is devoted to the dominant sugar crop. It is difficult to see the advantage of such a varied programme as is presented in this historical summary of the work of the station, especially as its original institution was due to a crisis in the sugar industry and its cost is entirely borne by the sugar planters. The following details regarding the *raison d'être* of the station and the work that it has done for the sugar planters have been extracted as likely to be of general interest.

Tucuman is the smallest and most thickly populated of the fourteen provinces of Argentina. It is situated in the northernmost part of the country and thus approaches the tropics—800 miles to the north of Buenos Aires and between 26° and 28° north latitude. The cane growing section lies between 1000 and 1650 ft. above sea level, and it has presumably both river and railway communication with the capital. The climate is distinctly sub-tropical with extremely hot summers and a maximum record of 115°F. in the shade ; but this heat is usually tempered by clouds and rain which occur at this time of year, as in most parts of the tropics. Rainfall is given as about 40 in. annually, falling chiefly from December to February, or in the growing period of the canes. The winters are cool and dry : fresh, sunny days, and cool, invigorating nights. About four out of five winters have frosts, and this factor dominates the sugar industry by putting a term to the growing season : if they occur early in the grinding season, the purity of the juice is affected and the stand of ratoons is liable to injury, especially when such frosts come shortly after warm, growing weather.

The establishment of the Experiment Station was brought about by a marked decrease in the yields of the cane fields during the early part of the century, and was chiefly due to the strenuous efforts of A. GUZMAN, one of the largest cane growers. The station was sanctioned in January, 1907, and the first Director appointed in 1909 in the person of R. E. BLOUIN of Audubon Park ; and a chemist, entomologist and mycologist were added within the next few years. On BLOUIN's retirement in 1914, A. ROSENFELD (entomologist) was in charge for two years, and was then succeeded by W. E. CROSS (chemist) who still holds the appointment. G. L. FAWCETT was appointed pathologist in 1914 and still holds that post, although also saddled with the botanical work.

Funds are obtained by a cess of 2 cents per ton of cane ground, and the money available for the work can thus be deduced from the table appended below. By an equitable financial arrangement this money has now been placed to the station's account with the local bank, so that the years of high tonnage can be made to support those of failure. The industry, like most others at any rate outside the tropics, is strongly protected, by a Government tax of 7 cents per kg. on imported sugar. The following Table gives the

tonnage of canes and yield of sugar from 1915 to 1925, a period of vital interest in the industry.

Year.	Canes ground (Metric tons.	Sugar produced (Metric tons).
1915	1,797,631	103,979
1916	883,436	44,527
1917	686,540	44,565
1918	1,650,226	86,878
1919	3,225,400	247,535
1920	2,488,642	165,018
1921	2,418,907	163,124
1922	2,472,583	177,244
1923	3,030,404	201,633
1924	2,567,713	176,267
1925	4,489,600	309,906

The old-time varieties of cane grown were of the Cheribon type, known in the New World as Louisiana Striped and Purple; and these were practically wiped out by disease (mosaic), culminating in the years 1915 to 1916. Fortunately, the early Directors had energetically collected other varieties for trial (whether thus introducing or spreading mosaic is not stated), and of the 300 got together, two were at once found to save the situation, namely the mosaic tolerant POJ 36 and POJ 235. The country was thus saved the necessity of guarding the industry against this insidious disease; and large numbers of cane varieties have continued to be introduced every year. The most important of these at present is given as POJ 2725. Besides this limited list of varieties grown, large numbers of seedlings have been raised locally by FAWCETT, and a thorough study has been made of any sports which have been observed.

The sources of irrigation are we believe good, but nothing is said about this by the author. A small proportion of cane fields is also grown without irrigation; and some useful work has been done by applying methods of dry farming on these: planting in deep furrows, deep ploughing and subsoiling and frequent light cultivations. The planting in holes instead of in furrows would also appear from experiments to be of advantage. Manurial experiments, as might have been expected, have been carried on from the first. The tendency however has not been towards a great system of artificial manuring, but rather towards the conservation and use of what might be termed the natural resources of the industry; the vital importance of cattle manure, the use of filter-press cake and ashes from the mills, and extended research on the possibilities of rotational work both as regards the growth of leguminous crops and pasture grasses, the latter for the all important supply of cattle manure, again referred to below. But an interesting new line has recently received marked attention, namely the use of sulphur and the possible use of what are called "catalytic fertilizers."

The general idea obtained from the manurial experiments appears to be, then, that although artificials may have an important future, they should be mainly used as supplements to the "natural" manures. POJ 36 has been found to respond more to nitrogen than POJ 213; and as regards the application of concentrated nitrogenous manures it has been decided that this would probably be better worked out by the plantations themselves on a large scale and in their local conditions. Ammonium sulphate is recommended as the cheapest outside form of nitrogen and at present eight concerns are carrying out such experiments, while others are testing nitrate of soda. The reason for this move is the varying and negative results obtained on the station plots.

Interesting results have been obtained with sulphur. The returns of three crops indicate that by harrowing in or applying to the cane plants direct 300 kg. per hectare, increases of 2·5 to 3 tons (of cane ?) can be obtained, and it is suggested that this increase is brought about by the unlocking of phosphoric acid and potash, as well as by destroying fungus spores and insect larvae. A fertilizer with 40 per cent. of manganese oxide did not have any apparent effect in spite of a successful application in Europe. The catalytic work may be described as medicinal; and, just as small doses of many poisons are of great value in medicine, a determined effort was made to apply this principle in the cane plants. This experiment, like that with manganese, had its origin in recent European work, e.g., small doses of manganese on oats and borax on corn; and may be divided into two series : (1) POJ 36 treated with 3·5 to 5 kg. per hectare of potassium iodide, manganese sulphate, borax and certain phosphates, and (2) Cheribon treated for mosaic with compounds of arsenic, barium chloride, borax, zinc sulphate, copper sulphate, lead acetate and mercury bichloride. None of these applications have as yet had any influence either on the cane or its juice; and even when increased to 50 to 200 kg. per hectare only borax showed an inhibition of growth. In spite of these negative results the experiments are being continued.

The usual experimental work inseparable from the sugar cane does not call for any special mention : soil preparation and cultivation, spacing, disinfection and selection of seed, number of rows of canes planted in the furrow, stripping sets before planting, selecting plant material from the upper parts of the cane, and so on, reveal nothing of interest outside the local plantation work. An important innovation, again of local importance, appears to be the experiment of planting the sets in the autumn (as has been tried in north India) because of frequent dry months after the winter; and great hopes are entertained of thus extending the limited growing period of the cane. The continued work on rotations appears also to be of great importance, by planting leguminous or mixed legumes and pasture after years under cane. Lucerne and Rhodes grass (*Chloris guayana*) have been found of special value, as occupying the land for several years. The latter is in fact now grown on all the roads and paths in the station, as it shows little tendency to invade the plots as does the Bermuda or devil grass or dub (*Cynodon dactylon*); the roads have been maintained in perfect condition for many years and of course afford valuable pasture for the cattle. Besides this, Rhodes grass and Lucerne appear to get on very well when grown together and form an ideal combination from the pasture point of view under Argentine conditions—a matter of great importance to the country at large.

With all this work on sugar cane it seems to be a pity that the few officers cannot pay their undivided attention to this crop. The author turns in the latter part of the paper to work on corn, cotton, sugar beets, peanuts and various forage crops; and it is obvious from the summary given of the work done in the various sections, both in experimentation and the extensive publication of articles and pamphlets, that these side lines must take up a great deal of time.

FIELD CONTROL OF SUGAR CANE ROOT DISEASE CONDITIONS. **J. A. Faris.** *Tropical Plant Research Foundation. Bulletin No. 6, 1927.*

This paper presents a clear exposition of the use of cultivation practice in the control of the " root disease" of the sugar cane, and incidentally demonstrates the value of a knowledge of agricultural practice for the plant pathologist. But the term " disease " embraces many different classes of ailments; and in no part of the cane plant can the transition between mere

saprophytism and active parasitism of organisms be more clearly recognised than in the underground portion, a condition in all probability due to the presence around the base of the stool of all stages between healthy, growing tissue and dead and decomposing parts.

The author states that, after two years of experiments with isolated pure cultures of the ordinary fungi attacking cane roots in Cuba, he has failed to observe active primary parasitism in any of them, with the exception of the Zonate Foot Rot, which occurs on extensive areas where conditions are otherwise favourable for the growth of the cane. For the rest, he considers that unfavourable environmental factors are by far the most important in the production of root diseases in the Cuban cane fields ; as these, by their reduction of the vitality of the plants, are the primary cause which enables the disease organisms to attack the living tissues. "The net result of the experiments to date indicate that, if this primary weakening of the plants by environmental causes could be avoided, the associated fungi could not cause the roots to rot." With this clear starting point, the various climatic and soil conditions of the Cuban cane fields are examined and the cultivation practices criticized, and where possible amendments suggested so that the general sanitation of the cane fields may be improved.

In the course of the paper, it cannot but strike the reader that both the soils and climate of Cuba are presented in an extremely unfavourable light. One presumes that this is to be put down to the attitude of the author, that of a physician who has been called in to prescribe remedies for widespread ailments : in such case naturally the weak spots are emphasized, and we must guard against drawing the conclusion that the patient is "in extremis." Nevertheless, it is obvious that the author considers that there are many cane fields in Cuba where the conditions are extremely unfavourable for the crop, and should never have been put under canes. Adverse conditions occur in certain types of Cuban soils, and it is suggested that a thorough survey and classification with reference to the chemical and physical characters of soil and subsoil would throw much light on this and similar enquiries. In some cases the adverse circumstances are inherent but amenable, while in others it is impossible to correct them ; and it is of great importance that this should be recognised, in order to prevent the growing of canes on the latter.

The main line of investigation concerns the amount of moisture available in the soil ; and this is considered first from the point of view of water-logging and then from that of deficiency. For the better understanding of what follows a note is here inserted by the writer on the Cuban rainfall, extracted from another publication. The following averages are for 19 stations during the period 1899 to 1924. Mean annual rainfall, 54·81 in. Seasonal : winter 5·45, spring 11·7, summer 19·53, and autumn 18·02 in. Monthly, January to December : 1·87, 1·57, 1·99, 2·80, 6·91, 8·29, 5·56, 5·73, 7·75, 7·04, 3·33, 1·97 in. A noticeable feature in the Cuban rainfall is the high degree of dependability on the amount during the growing months, May-November ; the average for the driest month July being 5·6 in. In no case has there been less than 2·5 in. for any month during this period. Greater variations are noticeable in the lighter, more fluctuating winter months. The rainfall is evenly distributed geographically, although somewhat higher in the west than the east of the island. This is doubtless due to the rains of the hurricane period, as the western end of Cuba lies close to the path of recurvature of the West Indian hurricane system. In all parts, the rainfall is least in January and February, with a steady increase to the maximum in May or June, a decrease in July and secondary maximum in September or October.[1]

[1] Rainfall and Temperature in Cuba. O L. Fassig. Tropical Plant Research Foundation Bulletin No. 1, 1925.

Waterlogging.—The difficulties in connexion with adequate drainage in the heavy flat lands and the coastal lands throughout the west of Cuba are clearly recognised. Where general flatness characterizes a tract, there is nothing but co-operative work to remedy the evil; and it is pointed out that if this can be arranged the problem will not only be solved, but in a very economical manner, and any purely local difficulties in drainage would be greatly assisted if such a general scheme were inaugurated. But much can be done in the absence of this. A very important preliminary step should be a very careful inspection of the fields immediately after the first heavy rains; small depressions can only be detected at this time, as later on they only declare themselves by the yellowing of the plants and their stunted growth. Such spots are then said to be suffering from root disease, grasses invade them and conditions rapidly become worse, till the canes begin to die out in the dry weather; and thus the "disease" spot becomes permanent.

In slightly sloping land of this character the furrows should be made down the slope. The land can thus be readily cleared of heavy rains, and the cutting of trenches in alternate middles in the ratoons greatly facilitated. Where stumps are still present (especially in eastern Cuba), it is impossible to smooth the depressions. But it is possible to arrange the times of planting and ratoon cutting, so that the young growths will have reached a decent height by the time that the annual inundations may be expected: the youngest plants always suffer most. Such areas are often the lowest on the estate and the last cut, whereas if they were cut first they would suffer much less at flood time. Lack of aeration through negligent cultivation should be in no need of emphasis, but the light colour and stunted growth of fields where the trash has not not been hauled to alternate middles and the bare middles cultivated, stand out in marked contrast to the rest and can be seen at a glance.

Tolerance to waterlogging is found in certain varieties: Cristalina has this character, and the following appear to have it also, POJ 2714, POJ 2725, POJ 2727 and D 433. To determine the length of time any variety can be ratooned takes time. The root systems may be excellent in freshly ploughed fields but be unable to develop in the harder conditions of uncultivated ratoons; in which case the premature drop in crop is usually put down to root disease, and the variety earns the name of being very susceptible to it. Proper cultivation of the ratoons may solve the problem, but this has not as yet been determined. In such soils, besides the waterlogging in the wet season, there is often an excessive cracking in the dry into hard blocks, with consequent tearing of the roots: hence a good variety must be able to withstand both. In all probability timely cultivation on some approved system would prove effective in handling such intractable soils.

Lack of moisture.—Root injury due to lack of moisture is very common on the porous red and savanna soils, on ashy grey and black soils underlain by *coco* and gravel, together with deeply cracking heavy black soils. Two obvious remedies occur: irrigation, and cultivation methods which will reduce run off and evaporation, keep down weeds and increase the organic matter in the soil. In the red savanna soils the time of planting is important, and to plant them in the spring is to court disaster—many other soils cannot be planted in the autumn because it is impossible to prepare them during the rains. If the canes are planted in the spring, the young cane, with abundant water develops a small rooting system, and when in October-November the rains abruptly cease they are in danger of dying; and at any rate they must be cut back to save the first ratoons. Such timely cutting back has

been proved experimentally to double the following ratoon crop. But these savanna lands can be prepared during the summer and autumn, and the best time to plant is just before the August-September rains, so as to give sufficient growth in the ensuing dry period for the shading of the ground. In the cooler, drier weather the roots continue to develop downwards, so as to be able to throw up the top growth when the ensuing great rains come in the summer. Both for controlling root rot, and for the economical management of lands capable of summer preparation, fall planting should be insisted on.

This relation between soil moisture and growth is very fundamental in quick drying soils, which are widespread and involve a very large percentage of Cuba's standard cane lands. In some years the rains are sufficiently well distributed for the cane to ripen properly, but this is the exception, and there is the danger of drying out before ripening. Here again it is important to employ varieties with a wider root system, and this question is well worth a more thoroughgoing study than has been given to it.

Another rather extensive type of soil injury is met with in some brown clay soils, about 6 in. deep, underlain by a yellow, friable almost impervious clay subsoil. With good preparation and suitable rains a good growth of canes is obtained, but if there is excessive rain very little penetrates the soil, and if there is a deficiency the plants dry out quickly because the roots cannot get into the subsoil. Both root system and water storage area are very limited and superficial, and although fair plant crops may be reaped, ratoons soon die out. Knifing such soils to a depth of at least two feet has been found to be very effective. Very considerable areas with this type of root injury may be found associated with Matanzas red soils throughout the south west portions of Cuba.

The proper cultivation of ratoons, aiming at absorption of rainfall and the reduction of evaporation, will overcome many difficulties. A very successful method is the hauling of the trash to alternate middles as soon as the young shoots indicate the rows clearly. Then *desaporque* (barring off or making furrows by throwing soil away from the rows) is made by large well sharpened ploughs working 4-6 in. deep, and drawn by 2-3 pairs of bulls. This aerates the base of the canes on one side, and when the middles are broken (by two passages of such a plough or one by a lister) the *desaporque* furrow is filled with loose soil, giving excellent conditions for new root formation : weeds which have started will be killed and covered : manure spread in the furrow will be placed close to the young roots : and, if irrigated, the first water can be given to the open furrow, and subsequent ones to the furrows in the middles. This system is easily manageable in west Cuba, but will be rendered more difficult in the east because of harvesting. The author concludes this section with the remark that, with such simple and well designed cultivation methods, much of the root disease will disappear.

Irrigation.—With the exception of certain coastal lands with sub-irrigation, practically every part of Cuba would benefit by additional water at some time or another during the year. This appears to be possible both by overground and underground streams ; and this development is worth a special study. Experiments and observations have established the fact that most of the root disease in the porous red lands can be attributed to the excessive drying out of the canes during the dry season. Irrigation with the timely conservation of moisture would do much to counter this evil.

Deleterious substances in the soil.—These are often very harmful to cane growth and predisposing to root disease. The most important in Cuba appears to be ordinary salt, which occurs on large tracts near the coast, but

also in the streaks and pockets in soils of the hilly parts. Where depressions occur, the salt is washed into these, with the curious result that, while cane growth may be satisfactory all round, stunted yellow plants are seen in the hollows. The canes on salt land suffer most during periods of drought, then recover when the rains come, again to suffer from drought; and this appears to be the origin of the reports of recurring attacks of root disease. When the salt concentration exceeds 0·15 per cent. in the soil, it is recommended that cane should not be planted, both in view of the probable result of a severe dry season, and also because of the well known effect on the juice. Among experimental data accumulated the following may be quoted: on land with 0·157 per cent. of salt, Cristalina cane gave 0·066 per cent. of salt in the juice, polarization was 68·2 and purity 89·1 : where the percentage of salt was only 0·119, polarization was 76·5 and purity 95·0. The general effect on growth is the production of a high proportion of slender stunted canes whose roots easily rot.

Lack of soil fertility.—This fault appears not to be the usual one, and is more or less confined to the porous red clay Matanzas type and some savanna soils; in other cases unsuitable physical properties, lack of cultivation and deficient rainfall, predominate. In the types of deficient fertility a general response is obtained with phosphatic manures, probably because of their stimulation on root development and thus correction of deficiency in moisture. A growth chart given for Cristalina, as regards temperature and moisture, shows a peak in May-July and a smaller one in September. The canes were grown on ashy grey alluvium with excellent moisture retention, unmanured, although cultivated in cane for 96 years. 66 per cent. of the growth occurred between May 15th and October 15th, which period coincides with the hot rainy season. One lesson to be learnt from this chart is the necessity for providing most favourable conditions (cultivation, manuring and so on), while the canes or shoots are young, so that full advantage maybe taken of the growing season. The proper time for manuring is before the spring rains, and the proper place is in the furrow before planting, and in the *desaporque* furrow in ratoons, so as to throw the roots down to the moister soil layers. Surface manuring brings the roots up, and causes rapid drying out when the rains cease: most of the cases of root disease induced by manuring are caused either by such surface application or applying it too late in the season.

Control of weeds and grasses.—Weed competition is one of the most prevalent sources of root failure, and Johnson grass (San Carlo or canuela) and Para grass (parana) are the worst; these grasses affecting porous soils and heavy black soils respectively. Johnson grass can be controlled in west Cuba by devoting the land to pasture for a year or so. The grass is eaten short and the ground well trampled, thus forcing the underground runners to the surface: the land is then repeatedly ploughed during the dry season. Thus several caballerias (33·2 acres) of heavily infested land have been cleared in one year. Para grass is more difficult to control because of the moister soil. The following method proved successful in one season on pasture land in alluvial flats. As soon as dry, the grass was burnt off, and the ground ploughed up in large clods by a steam plough : harrowing followed three weeks later. A month later it was cross ploughed, and harrowed after another month. After the canes were planted, any occasional root left could easily be pulled up by hand. The cost worked out at $800 per caballeria and could be somewhat reduced. In both cases the principle was to expose the underground parts to the hot sun during the dry weather.

Other limitations of root growth and development.—High cutting of the canes is one of the most important faults in east Cuba, where a thick blanket of trash makes precision difficult. The result is that several high buds develop in the stump, and these being without roots drain the moisture from the stool. If properly cut low down, the underground buds emerge and soon develop their own roots. Cutting back after accidental burning is generally recommended, because of the loss of water from the injured stalks or young shoots. It has also the important advantage that it makes low cutting at harvest time easier in ratoon crops, in that the burnt canes if left become excessively hard and interfere with the cutters. Unprofitable subsoil is often met with. In all parts there are areas with thin soils over unproductive subsoils—coco, gravel, sand, putty like, and so on. Here root growth is limited to the upper layers, and such areas should be abandoned as far as sugar cane cultivation is concerned.

RECENT RESEARCHES ON PLANT VIRUS DISEASE. **H. H. Storey.** *South African Journal of Science*, xxiii, 307.

In studies of streak disease of maize, the author failed to transmit the disease by any method of direct inoculation. Inoculations were made by leaf mutilation and by hypodermic syringe, using juice, diluted and undiluted, from diseased maize plants and from crushed infective leaf hoppers of the species, *Balclutha mbila* Naude. In life this hopper is a highly efficient vector of streak disease.

Experiments upon the infection of *Balclutha mbila* by the streak virus demonstrated a period of uninfectivity of the insect immediately following feeding upon a diseased plant. Incubation periods of the virus in the insect were determined at different temperatures, and were of the same order of size as those found by American workers for the sugar beet curly-leaf virus in *Eutettix tenella* Baker.

The power of infection was only rarely lost by the individuals of *Balclutha mbila* under experiment. One individual remained infective to maize after four months, during which it fed solely upon healthy sugar cane. In certain cases, however, a definite loss of infective power was demonstrated.

Measurements of the rate of movement of the streak virus down the leaf after inoculation, following Severin's method of cutting off the leaf after known times, showed that the virus moved down rapidly, the highest figure obtained being 40 cm. in three hours at 30° C.

By the employment of a technique which limited the feeding of the hopper to chosen areas of the leaf, it was demonstrated that the distribution in the diseased maize plant of the virus of streak, in so far as it was available to the feeding leaf hopper, was uneven. Whereas 70 to 80 per cent. of hoppers obtained the virus after a short period of feeding upon the chlorotic areas of the leaf, under similar conditions under 15 per cent. obtained the virus from the green portions of the plant, including the green areas which separated the chlorotic stripes upon the fully diseased leaf. In this partial localization of the virus to the chlorotic areas of the leaf, streak disease is thought to show a point of similarity to Bauer's infectious chlorosis of the *Malvaceae*.

C. A. B.

Regarding the position of the Falkiner[1] cane harvester in Queensland, it is reported that two machines have been built with certain improvements resulting from last year's trials. These machines will be operated under field conditions in order to determine whether they may now be considered a commercial success.

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[1] *I.S.J.*, 1926, 51, 444.

Commercial Determination of Sugar in the Beetroot..

Using the Sachs-Le Docte Process.

By ARMAND LE DOCTE.

The Sachs-Le Docte process being in general use at the present time for the commercial analysis of the beet, and being, in fact, specified very frequently also in contracts as the method to be employed for the determination of the sugar present, requests have been received from factory managers and others interested for clear directions on the exact *modus operandi* to be followed in order thus to avoid differences of opinion that otherwise may arise.

General Practical Instructions.

Actually the procedure followed is the cold-water, instantaneous diffusion method, originated by H. Pellet, the details of which have been worked out by François Sachs and Armand Le Docte. This process, extremely simple, rapid, and consistent in its results, eliminates entirely the various sources of error in the older methods. It is now adopted universally, and the method of operating, and the use of the apparatus, are in brief as follows :—

Convert the beet into a fine pulp, using the apparatus shown (Fig. 1); *weigh* 26 *grammes (or whatever the normal weight of the saccharimeter used may be) into the metallic capsule (Fig.* 2); *add by means of the automatic pipette (Fig.* 3) 5 *c.c. of basic lead acetate solution at* 30° *Bé* (55·2° *Brix, or* 1·26 *specific gravity) together with* 172 *c.c. of water, that is in all* 177 *c.c.*; *cover the capsule by means of the metal disc enveloped with the rubber cap (Fig.* 2); *shake its contents violently for about* 6 *seconds*; *filter*; *add two drops of glacial acetic acid to the filtrate*; *and lastly polarize this in the* 400 *mm. tube. The reading obtained is the percentage of sugar in the sample.*

Production of the Pulp.

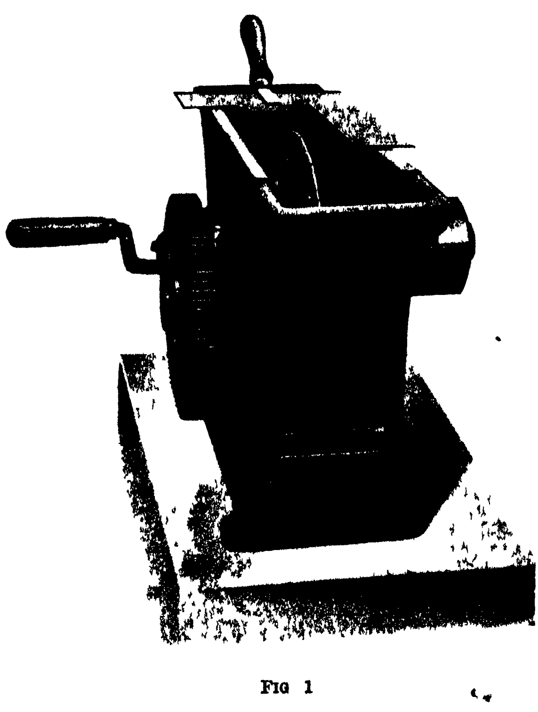


Fig 1

The Sachs-Le Docte process requires a pulp that is so fine that, on simply agitating with water, the diffusion of the sugar takes place instantaneously and completely. Such a pulp can be obtained by means of the Pellet conical rasp with a special steel cutting disc, which at once removes a triangular section proportionally along the axis of the root. Its action is very rapid (a very important condition, practically, as well as from the point of view of accuracy), and the production of unrasped parings or particles is reduced to a minimum, in fact can generally be neglected.

The rapidity of rotation of the disc should not exceed 350-400 revolutions

per minute, in order to avoid the formation of heat by friction, and also to minimize the draught of air, both of which conditions are likely to cause evaporation, and in consequence cause too high a result. For the same reason the teeth of the crest of the disc should be kept very sharp, being edged with a file when use has blunted them to the point where rasping is appreciably slower.

The beets comprising the sample are rasped half of them through the larger, and the other half through the smaller diameter, being simply held by the hand in such a way that the crest of the disc presses as regularly as possible along the axis of the root. This condition need not, however, be imposed too rigorously, because in practice small inequalities in rasping different roots composing a sample generally become compensated.

After rasping is finished, the cutting surface is cleaned by the application of a brush having stiff bristles. It is absolutely necessary to stop the rotation of the machine when it is empty between the treatment of any two samples, otherwise any matter adhering to the disc is dried and becomes retained in the teeth, an increase in the sugar content of the following sample thus occurring. Though such errors arising from desiccation considered singly may be small, their total effect being all in the same direction may mean an appreciable difference in the result.

The pulp produced is afterwards carefully mixed by means of a large iron spatula, the few rootlets and unrasped parings or particles which may be present being at the same time removed. One then selects by hand from five or six different parts of the heap small portions of the pulp, which are placed in a covered container to await weighing.

Weighing of the Pulp.

The pulp is weighed directly into the metallic capsule (Fig. 2) small lots being taken from five or six different parts of the container, always avoiding the removal of any unrasped *débris*. By the use of the Pellet rasp with the special disc, and by operating according to the directions just given, it is extremely unusual to find any unrasped pieces at all in the pulp; and if any be encountered their amount will be insignificant and without effect on the result. In fact, the end of a rootlet, a piece of peel, or other such scrap having a weight of 160 mgrms. (a weight of a relatively large piece) would make a difference only of 0·10 per cent. in the case of a root having 17 per cent. of sugar, assuming this had left behind none of its sugar dissolved as juice. Inspection of the mark (or insoluble matter) left in the funnel after the filtration, enables one quite easily to detect the presence of unrasped fragments.

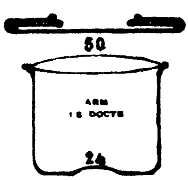


Fig 2

When making a number of analyses it is very convenient to employ capsules all tared to the same weight, so as to have only one counterpoise for the lot, and this counterpoising need be correct only within 20 mgrms. Since by continuous use, the weight of the capsules alter, it is necessary from time to time to correct the tare, and rather than interfere with the capsules that have altered in weight it is preferable to construct a table giving the numbers of the capsules and the weight to be added to balance the counterpoise, neglecting any less than 20 mgrms. At the end of the season, however, it may be advisable to re-adjust the tare of all the capsules to the single counterpoise, removing by means of a suitable scraper some of the piece of solder which is found outside in the bottom of each.

MEASUREMENT OF BASIC LEAD SOLUTION AND WATER.

The automatic pipette (Fig. 3) measures separately the basic lead acetate solution and the water, and mixes the two liquids at the same time. It does away, therefore, with the necessity of previously preparing large volumes of the mixture, but it also allows of the increase or decrease of the amount of basic lead acetate solution, when this is required, as in special cases (e.g., when dealing with unripe or damaged roots).

In fixing up the automatic pipette, the tubulure *B* (Fig. 3) is connected with the vessel containing the basic lead acetate solution; the tubulure *C* with the water reservoir; and the tubulure *A* with any receiver (Fig. 5), while the top discharge *H* should project 1 cm. at least (say ½-inch) beyond the interior opening of the tubulure *A*. The distance between the end of the discharge tube *D* from the capsule *T* (Fig. 4) should not be more than 2 to 3 cms. (say ⅞ in. to 1¼ in.), in order to avoid possible loss by splashing when running off the liquid.

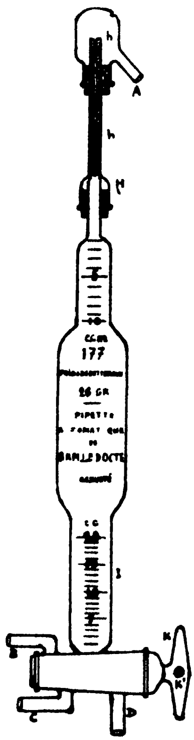


FIG 3.

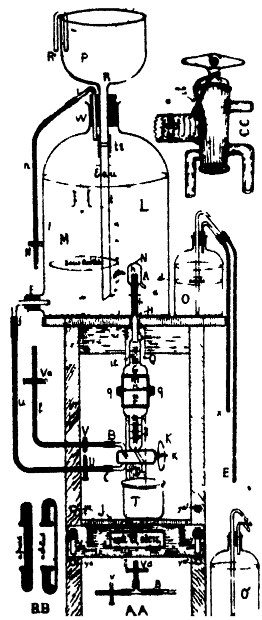


FIG 4.

By turning the handle *K* of the tap of the automatic pipette quarter-of-a-turn, the basic lead acetate solution rises in the pipette, and it is allowed to do so until it reaches the line marking 5 c.c., when a second quarter-of-a-turn of the handle *K* causes the water to enter and to mix with the reagent; as soon as the liquid overflows through the tube *H* a third quarter-of-a-turn closes all the communications. Then the capsule containing the pulp being placed under the tube *D* a fourth quarter-of-a-turn of the handle *K* makes the entire contents of the pipette discharge into it, the handle *K* of the tap being then

set in its original position. When the liquid has been discharged from the pipette, there still remain in tube D two or three drops, a negligible quantity anyway, which, however, does not affect the volume, since it persists after each operation of the pipette.

It is unnecessary to use distilled water, as rain water, or good well water will do, though in this latter case it will be necessary to ascertain the extent to which the basic lead acetate solution is "neutralized." If this quantity exceeds 0·5 c.c., then it will be necessary to increase the amount of this reagent accordingly by altering the position of the calibrating line I, or simply by indicating the level of the volume to be measured by means of a thin rubber ring.

Agitation of Pulp and Liquid.

In doing this, one places the metal disc enveloped with the rubber cap (Fig. 2) on top of the capsule, pressing it down quite firmly against the edge of the vessel. Then one shakes quite vigorously with an up-and-down movement during about 6 seconds without turning over the capsule, this operation being finished by imparting to the liquid a gyratory movement in order to carry down the pulp which may have lodged in the upper part of the vessel. When removing the cover, it is slid against the top edge of the capsule, so as to separate the particles adhering to the rubber. Filtration should follow immediately after uncovering.

Filtration.

It is necessary to use funnels having a diameter of about 11 cms. (4⅜ in.), and filter-paper circles of 21·5 cms. (8½ in.) diameter folded simply into four, thus giving a large surface, capable of holding the entire contents of a capsule.

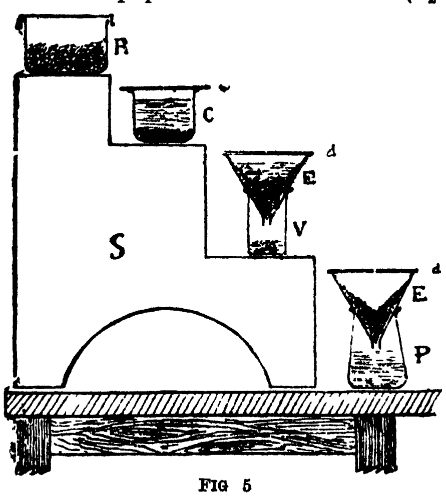


FIG 5

During the whole of the operations previously described, evaporation of water has taken place, small, it is true, at any single stage, but continuously during rasping, mixing, weighing, and filtration. It is, therefore, necessary to avoid so far as possible any further concentration during filtration which may become quite marked when the temperature is high. To this purpose, one uses with advantage the arrangement shown in the drawing (Fig. 5) in which R is the vessel containing the sample of pulp, which is kept until the end of the analysis in case of accident, or for making a second control test; C represents the capsule after agitation still covered; V is a cylinder of 125 c.c. capacity, in which is placed the stem-less funnel E, 11 cms. (4⅜ in.) in diameter containing 21·5 cm. filter-paper circle folded as directed; P is a conical glass holding 250 c.c., its top edge being slightly bent over; all of which vessels are arranged in series along the shelves of the support S, as shown.

In commencing filtration, the entire contents of the capsule C is poured into the funnel E, and the cover used for the capsule is transferred to the funnel. As soon as the filtrate running into V has commenced to run clear, the funnel E is transferred to the conical glass P, the few c.c. left in the cylinder V being

poured into the funnel E.[1] Two drops of glacial acetic acid are added to the contents of P, which is then mixed and polarized in the 400 mm. tube.

VERIFICATION OF THE PIPETTE.

After well rinsing the pipette, it is filled with distilled water, and its contents allowed to flow through D into a capsule that has been exactly counterpoised, which is weighed. The result obtained will indicate the weight of water run off, which should be 176·7 grms. at a temperature of 20° C., for the 177 c.c. pipette used with 26 grms. of pulp. A difference of 300 mgrms. from the above weight can be neglected. Or, more simply, one can run the contents of the automatic pipette into a graduated glass cylinder (which has been accurately calibrated), in which case the water generally used, or even the mixture of basic lead acetate and water, can be employed.

TESTING THE FINENESS OF THE PULP.

The pulp should be of such a degree of fineness that diffusion is really instantaneous ; and one can be assured of this by operating in the following way : Two capsules are prepared with the same pulp ; the first is filtered immediately after violent agitation during 10-15 seconds only ; while the second is filtered at the end of 30 minutes after having been agitated every five minutes for a few seconds each time. Then the difference between the two polarizations should not exceed 0·2 per cent. of sugar in a single test, and 0·1 per cent. for an average of six tests, the proper mixing and accurate weighing of the pulp being assumed, and also the observation of all the precautions regarding the elimination of unrasped rootlets, skin, etc. It is evident that if an unrasped particle of pulp passes into the capsules a difference in the polarization, which may erroneously be attributed to the insufficient fineness of the pulp, will be obtained.

CONSTANCY OF THE VOLUME OF THE PIPETTE.

Theoretically the volume of water and of basic lead acetate solution to be added to the normal weight of pulp should be varied a little according to the sugar content of the sample and the density of the juice. In the following table is given the error which may result, while keeping the volume of liquid constant throughout, but with varying sugar contents and juice densities. One can see that in each case it is negligible :—

Sugar content of the Pulp. Per Cent.	Density of the Juice. Degrees Baumé.	Error in the Polarization. Per Cent.
10	5·2	0·03
12	6·1	0·02
14	7·0	0·01
16	7·9	*nil*
18	8·8	0·02
20	9·7	0·04

In a paper read at the Surveyors' Institute recently, Mr. G. TURVILLE BROWN endeavoured to answer the question as to what would happen to the beet industry when the subsidy lapsed. It will, be essential, he said, that all factories shall have full supplies of beet for each year's campaign within a comparatively small radius from them, as, when competition is keen, every penny saved in rail, water, or road transport charges will be of importance. It will also be vital that farmers should recognize that it is uneconomical to grow anything less than a full crop. British average production would have to be increased above the crop obtained in even so favourable a season as 1926. The farmer also must learn to make the best use possible of his by-products.

[1] This part of the operation can be avoided by using filter-paper capable of giving a perfectly clear filtration with the first drop, and these are now obtainable in a cheap, rapid-filtering quality.

The Czecho-Slovakian Sugar Industry.

(Department of Overseas Trade Report.)

In his annual report on the Industrial and Economic Situation in Czecho-Slovakia dated March, 1927, the Commercial Secretary to H.M. Legation, Prague, has the following to say on the sugar industry of that country :—

The present sugar season shows a large decrease over last year's production. Owing to the low price fixed for beet at the beginning of the year 1926, the area sown was less than that sown in 1925, and the reduction in the quantity of beet produced and worked up was accentuated by rains in the early part of the year. Up to the end of January only 6,232,987 metric tons of beet were worked up, as compared with 8,824,175 tons in the whole season of 1925-26. The production of beet per hectare was very much less than in 1925-26 when the yield was 28·3 tons per hectare.[1]

The statistics at present available are as follows for the seasons indicated :—

	Season of 1923-24.	1924-25.	1925-26.	1926-27.
Area under beet cultivation in thousand hectares	232	303	307	278
Sugar beet production in thousand tons	5,823	8,230	8,824	6,233
Sugar production (raw sugar equivalent), thousands of tons	1,011	1,428	1,507	1,030
Sugar exports (thousands of tons)	660	991	1,080	650

The internal wholesale price of sugar current for the season 1925-26 was 440 Kr. per 100 kg. At the end of Government control in October, 1926, it was increased to Kr. 502. The increase was stated to be due to the increase in the tax on sugar from Kr. 152 per 100 kg. to Kr. 209. The Government then intervened and a compromise was made fixing the price at Kr. 448 per 100 kg. for three months, but it was again raised in January to Kr. 516. The Prime Minister stated, in reply to a deputation, that it was intended to remit some part of the tax on sugar in order to lower the price to the consumer, but nothing has yet been done.

The forecast for 1927-28 is for a somewhat greater production. The price fixed for sugar beet for the season 1927-28 is higher than last year. According to a price agreement made between growers and refiners in the Bohemian beet districts for the season 1927-28, the beet growers have the right to choose either the fixed price, amounting to Kr. 18·50 per 100 kg., or the sliding price. This latter price will vary according to the average price of raw sugar between June 1st, 1927 and January 31st, 1928. If the raw sugar price remains below Kr. 175 per 100 kg. the beet price will amount to 8¾ per cent. of the sugar price. If, however, the price for raw sugar exceeds Kr. 175 per 100 kg. the beet grower will receive 8¾ per cent. of Kr. 175 plus 11 per cent. of any amount over Kr. 175. The growers are guaranteed a minimum price of Kr. 15 per 100 kg.[2] net weight of beet. These prices were not fixed by the Cartel but by a meeting of growers and refiners, called as a last resource by the Minister of Agriculture after long negotiations between the two parties had yielded no result. The higher beet prices lead refiners to expect that a larger area will be sown, and it has been estimated that the increase will be about 10 per cent. over last year, when it was 277,797 hectares. There is, however, some uncertainty on the point, as some of the refiners still stand outside the agreement.

The exports of sugar amounted to 1,080,000 tons during the season 1925-26. The principal destinations, together with the quantities sent there, were :—

	Tons.		Tons.
Hamburg	352,909	Austria	110,498
Great Britain	190,055	Italy	35,563
Trieste	175,921	British East India ..	15,052
Switzerland	135,371	Germany	14,331

It will be seen that over one-third of the total exports were sent to Hamburg, and it may be surmised that some part of this quantity was re-shipped to Great Britain.

[1] Say 11 tons to the acre. [2] Say 18s. 4d. per ton, at 164 kr. to £1.

An Improvement in Raw Cane Juice Clarification.

By ARTHUR WRIGHT, M.E., Author of "Industrial Filtration."

The desire has always been present to obtain better clarity in defecated juice and to have better machinery to handle the *cachaza*, or mud in cane cane sugar factories. In 1915, and again in 1916, the writer had the opportunity of experimenting along these lines in two mills in Eastern Cuba. It was fairly well established that the contrariness of the flocculent solids in the *cachaza* and the well-nigh colloidal particles in the decanted juice required apparatus, the mechanics of which had not yet been developed; but most necessary was the need of better flocculation of the liquors.

Old-time refinery practice prompted the experiment of more complete flocculation. The phosphoric acid and milk-of-lime precipitate produced a clear break in the liquor between the flocs. The economies of the costs of this treatment however, are discouraging unless some authority can prove that the insoluble calcium phosphate added to the *cachaza* cake is available phosphate food for cane growth, when the *cachaza* is properly distributed on the cane fields. Several planters, skilled in the fertilization on the various varieties of sugar cane grown in Cuba, were consulted on this phase of reducing the costs of manuring with phosphoric acid and lime, but their negative enthusiasm severely dampened interest in further pursuit of the proposition. It is not easy to prove that the precipitated phosphate becomes available fertilizer, but a bigger task still remains: to demonstrate how the *cachaza* cake can be spread properly on the fields when in the wet form.

The next attack was to parallel modern refinery practice in the addition of a filter-aid for filtration. The principle was easily proven, but the quantity of "Filter-Cel" required, again raised the economic question of cost. Every defecated juice and every *cachaza* tested in those two years yielded to the treatment, but in no case could a satisfactory filtering operation be obtained when the addition was limited to that amount which would make the treatment economically sound. A search for cheaper substitutes was undertaken, but unsuccessfully; while a process for recovery was worked out, but the conclusion of these tests was that the problem is far different from that when recovering the filter-aid from refinery filtration.

Finally, the idea of increasing the efficiency of the filter-aid itself was referred to the manufacturers of "Filter-Cel," and the entire sugar world is a witness to the progress made by the Celite Products Company in this direction, the marked improvement in the filtering capacities obtainable with "Hy-flow Filter-Cel" being a true achievement.

The advent of hydrogen ion concentration leading to the study of *pH* has had a most wonderful application in the matter of the critical liming of raw sugar juices. From the practical filtration point of view, however, the absolute *pH* at which a particular sugar juice is better flocculated is hardly of less concern than the matter of maintaining a uniform *pH*. It takes but one bad charge to clog up a filter-cloth and upset the routine of operation. Therefore, sufficient flocculation by the critical treatment with lime must be accompanied with means of uniformly maintaining that critical point. The range of variation is limited, and the product fed to the filters must not drop below a definite minimum.

I have recently concluded a set of experiments at Central Amistad, my first opportunity to revisit Cuba since 1916. I was struck with the very fundamental work being done by Gilchrist & Company at that mill; and I believe that, irrespective of any further advance they may make, they have

contributed to a solution of the clarification problem. I was able to establish a cycle of operations that will enable engineers to modify the standard "FEinc" filter so to continuously filter their settled *cachaza* without dilution, to wash out the sugar with very minimum amount of water, and deliver the cake with less than 50 per cent. moisture. I was able also to develop a filtering cycle of operations that will allow us to offer a continuous filtration of the decanted clear juice so as always to send a brilliant filtrate to the evaporators.

These results remind me of the work done in sugar refineries in 1913 and 1914. The introduction of self-discharge filters at that time established the axiom : 85 per cent. of any filter problem is to make the material filtrable, 15 per cent. of the problem is a choice of the mechanical filter. I have no hesitation in bringing to the attention of every raw sugar man the real contribution Gilchrist & Company have made in their work at Central Amistad. The cost of treatment is not increased ; it probably calls for less lime than liming, and it is rational to expect that the yield is very substantially increased. Certainly the difference in the quality of the sugar made this year, in spite of handling cane badly affected by the October hurricane, as compared to that made last year, is a mute testimonial of the value of uniform and controlled treatment of the raw juices.

Publications Received.

Methods of Analysis and Data used in the American Beet Sugar Company's Factories. F. R. Bachler. (American Beet Sugar Company, Oxnard, Cal., U.S.A.). 1925.

This book may well be recommended to beet factory chemists. It consists of a collection of methods drawn from various sources, some of which have been modified for the particular needs of the Company for which it has been compiled and all of which are very clearly described and accurately stated. It contains directions on the verification, adjustment and care of the polariscope, for making the direct and inversion polarization, and for the determination of invert sugar, density, dry substance, purity, alkalinity and acidity and ash. Special methods are described for the analysis of coke, coal, limestone, soda, ash, sulphur, kieselguhr, and other products used in the beet factory; and instructions are given for compiling the daily operating report, and the monthly extraction statement. and finally there are a number of useful tables. In general the methods used are standard ones (the Le Docte process is used for the determination of sugar in the beet) and the book (which is in loose leaf form) has been written with evident care. One is impressed with its practical value for the use of the beet factory chemist.

Der Gegenwärtige Stand der Anwendung von Aktivkohlen in der Zuckerindustrie. Dr. Oskar Wohryzek. Tagesfragen aus der Zuckerindustrie, Heft Nr. 5. (Albert Rathke, Magdeburg, Germany). 1927. Rm. 4.

Dr. Wohryzek has written this booklet as a guide for the use of the Continental technologist looking into the claims of decolorizing carbons as means for the refining of sugars. It contains a deal of information on the subject in a small space, and may well be recommended to those desiring to study the claims made for the various preparations at present on the market on the Continent, as "Carboraffin," "Anticromos," "Radit," "Polycarbon," the various grades of "Norit," etc., etc.

Yield Tests of Disease-Resistant Sugar Canes in Louisiana. R. D. Rands and Sidney F. Sherwood, U. S. Department of Agriculture, Department Circular No. 418. (Superintendent of Documents, Washington). Price : 5 cents.

Contents : Introduction. The varietal testing project. Experimental methods (plot technique ; methods of sampling, analysis, and calculation) ; varieties tested in 1926. Summary. Literature cited.

Die Trockentechnik. (Technology of Drying). M. Hirsch. (Julius Springer, Berlin). 1927. Price : Rm. 31.80.

This is a theoretical and practical work on drying. In the first section the author discusses the general physical principles of artificial drying, the heat balance of evaporation and of drying, the efficiency of drying, the graphic presentation of the condition of damp gases and materials, interchange between damp gases and materials data for the design of processes, the design of air-drying processes, the design of drying processes by heat transfer through heated surfaces, and the calculation of the methods, describing the machinery and plant used, and giving data on the application of these methods to particular examples of drying. This is a very useful small work, which may be read by those interested in the subject to supplement the information given in Hausbrand's well-known book.

Die Maschinentechnik in Zuckerfabriken und Raffinerien. Karl Schiebl. I. Teil. (Schallehn & Wollbrück, Magdeburg, Germany). 1927. Price : Rm. 12.

Books written specially for the engineer of the sugar factory are few and far between, so the beet industry, or rather the section of it reading German, will doubtless welcome a book that treats in its first part of the handling of roots (loading, conveying and unloading apparatus), coal, ash and clinker, slices, limestone, carbonation scum, and of sugar. This part of the volume is very well done on the whole, the author having apparently had experience in this field which has enabled him to collect useful data. There is later a shorter section on weighing machines, and one dealing mainly with pumps, the book being concluded with a few pages giving piping calculations.

Les Sucres et Leurs Dérivés. Marc Cramer. Encyclopédie Scientifique Bibliothèque de Chimie. (Gaston Doin & Cie., 8, Place de l'Odéon, Paris). 1927. Price : 28 fr.

In a preface to this book written by Mr. A. PICTET, it is pointed out that during recent years the chemistry of the sugars has been transformed, and has been complicated rather tham simplified, and a good deal of contradictory data has been published. Recognizing this, the author has written a work intended to be *read* rather than merely consulted. That is to say, he presents not a reference book but a volume to be perused by the student for the purpose of indicating, not only the present state of our knowledge of the subject, but also the importance of numerous obscure points, and, for the purpose moreover of showing the direction in which it would seem future work will tend. The author writes on his subject clearly, and the work is certainly one which may be read generally by the student with advantage.

The British Sugar Beet Society.

Appointment of Mr. W. T. Chadwin as Secretary.

At a meeting held at the offices of the British Sugar Beet Society on Thursday, 8th September, Mr. W. T. CHADWIN was appointed Secretary, in succession to Mr. ALFRED WOOD, who, it may be remembered, resigned his secretaryship a short while ago in consequence of the pressure of other business. The offices are now removed to 28, Westminster Palace Gardens, Artillery Row, London, S.W.1, and all communications respecting this Society should be sent to Mr. CHADWIN at that address.

It may be recalled that Mr. CHADWIN was Secretary and Technical Adviser of the British Sugar Beet Council formed in 1909-10 to take over and extend the work of the Sugar Beet Committee of the Central Chamber of Agriculture set up in 1898. He was, therefore, intimately associated with the beet sugar movement in its earlier stages.

Brevities.

We learn that the "Suchar" Refinery attached to Illovo Sugar Estates, Natal, is now operating satisfactorily. The granulated sugar produced is stated to be of the highest quality and to be unsurpassed in the Union.

The 1924 Census of production of the United Kingdom gives the selling value of sugar making and refining machinery (other than centrifugal machinery) turned out during 1924 as £817,000.

The great and increasing importance of the developments in their spectrometers and allied apparatus has decided Adam Hilger Ltd., London, to discontinue the manufacture of saccharimeters and dipping refractometers, which they took up in 1919, in order to devote the whole of their resources to the specialities which they have themselves originated.

The sugar beet nematode is stated by GERALD THORNE[1] to be established in practically every important beet growing section of the western half of the United States. If effective measures of control are neglected, the pest, he says, will doubtless soon become serious. In order to identify and locate infected fields, a survey is being made. Crop rotation is the outstanding method of controlling this plant disease, which causes "beet weariness."

Comparing 1925-26 productions of sugar with those for 1913-14,[2] the following are percentage increases or decreases: World, +35; Europe, —7·8; Cuba, +90; Java, +80; India, +28; U.S.A., +30; Japan and Formosa, +164; Brazil, +317; Peru, +38; Santo Domingo, +254; and other countries, +78 per cent. The world increase was 6,641,330 tons; that of Cuba, 2,300,000; and of Java, 1,000,000.

Prof. Dr. ALEX. HERZFELD, retired Director of the Institut für Zuckerindustrie, in Berlin, in an article[3] sketches the formation and development of the International Commission for Uniform Methods of Sugar Analysis until the discontinuation of its sessions as the result of the war, and concludes with the following remarks: "The natural way of reviving its pre-war activities would be again to call together the official, still existing Commission, to allocate new powers, and to extend the programme of work."

Mr. W. E. DESPLACE, of Natal, has invented a cane planter, which is claimed to be simple, cheap and strong. It is an attachment to a ridging plough, against the handles of which is placed an oblong iron box, in which the cane sets, cut into 2 ft. lengths, are carried. A seat is provided in front of this box for a native, who picks up the pieces of cane and drops them into a vertical pipe through which they gravitate into the furrow, forming a continuous line of cane sets. The plough, which precedes the planter attachment, has already made a furrow into which the pieces of cane fall in close succession. The sets can be left exposed for fertilizing, or if desired covered immediately by an attachment in the form of a small broad wheel, adjustable as to distance, placed about 5 ft. from the share. The planting machine is adjustable in the front to regulate the depth of the share.

According to L. C. MILLER in *Sugar News*, a good deal of oil is wasted in locomotive practice. No steam locomotive on a Philippine central requires more than a pint of cylinder oil per 100 miles or per 8-hour day of shunting service; and $1\frac{1}{2}$ pints of good engine oil per pint of cylinder oil is good practice. The following Schedule of Drops is offered as a useful guide for the adjustment of locomotive lubricators for the pint per 8 hours: Size of Drops, $\frac{1}{8}$ in. gives Drops per Pint 28,240; $\frac{3}{16}$ in. 8369 drops; $\frac{1}{4}$ in. 5530 drops; $\frac{9}{16}$ in. 1087 drops. First find out the size of the drop in each particular lubricator, then divide the number of drops per pint corresponding to the size of the drop by 480 (minutes in 8 hours). The result is the correct number of drops per minute. These rules apply, however, only to high grade steam cylinder oils.

[1] *Through the Leaves*, 1927, **15**, No. 7, 286.
[2] *Facts about Sugar*, 1927, **22**, No. 16, 375.
[3] *Vereins-Zeitschrift*, 1927 227-228.

In the article by J. A. AMBLER entitled "Amino Acids and Related Compounds in Sugar Products," the following two errata which appear on page 385 of the July issue are to be noted: In the tabulation in the middle of the page, under N found, mg., 1·009 should be 0·009; and in the last figure of this page, 0·01 should read 0·02.

At the Eynsham Experimental Station of the Institute of Agricultural Engineering, University of Oxford, a plant is being erected for the treatment of 20,000 to 25,000 tons of fresh beets per annum according to the process invented by Dr. B. J. OWEN and his colleagues.[1] This new factory is under the control of the Sugar Beet and Crop Dryers, Ltd.

Mr. H. C. MUNSON, Superintendent of Peterborough beet factory, lecturing recently to farmers, made the following statements: Careful experiments had indicated that healthy beets stored in the factory bins lost about 2 lbs. of sugar per long ton of beets per 24 hours, whereas healthy beets stored in piles under proper conditions lost only about eight-tenths of a pound of sugar per long ton beets per 24 hours. Beets that were very dirty or rotten, or both, lost sugar much faster during storage than those that were in good condition when stored. Most of the districts around Peterborough should raise 15 to 18 tons to the acre. High land beet probably contained a slightly greater sugar content, and better purity than the fen beet, but there was not a great deal in it. His factory dealt with 65,000 tons of beets in the last campaign.

The new basis of payment for cane in South Africa which as already recorded[2] is in terms of sucrose content, has been in force a few months; but it is apparently giving rise to considerable dissatisfaction amongst some of the farmers because it has led to the rejection of a good deal of cane owing to the declared sucrose content being lower than that demanded by the scale of payment.[3] It is predicted by some that this system of payment on the sucrose basis must fail, though the majority agree that judgment should be reserved until the end of the season when the complete average figures will be available in order to make comparison with previous returns under the old system.

Several members of the House of Commons having stated that the prosperity of the British refining industry was being jeopardized by the importation under the preferential duty of sugar refined in the Empire, Lieut.-Col. IVAN DAVSON[4] quoted 6435 tons as being the figure for imported Empire-refined sugar. Mr. WALTER FORREST, M.P.,[5] replied that Mauritius imports from 200,000 to 250,000 tons, all of which is over 98° polarization. Col. DAVSON[6] rejoined to the effect that most of this Mauritius sugar goes to the British refiner, only 80,000 tons being perhaps a fair estimate of what actually goes into direct consumption. Even with this added, the amount of directly consumed sugar imported under the tariff preference represents only about 12 per cent. of that imported from foreign sources, and is only about 5 per cent. of the sugar consumed in the U.K.

Amongst new companies recently registered in the U.K. are the following: Boncar, Ltd. (221,416).—Private. To acquire patents relating to manufacture of carbon or any allied substance, etc. Nominal capital, £250 in 1s. shares. A. H. Bonnard, The Ivanhoe Hotel, Bloomsbury Street, London, W.C.1 (director). Hulett's South African Refineries, Ltd., London House, 35, Crutched Friars, E.C. 3. (Registered in South Africa). To acquire from Sir J. L. Hulett & Sons, Ltd., their refinery at South Coast Junction, and to carry on the business of sugar refiners, etc. Nominal capital, £250,000 in £1 shares. British Sugar Developments, Ltd. (222,376). Private. Sugar refiners and manufacturers, etc. Nominal capital, £5,000 in £1 shares. Bedfordshire Sugar Co., Ltd. (222,347).—Public. Nominal capital, £2000. Sugar Industry Auxiliaries, Ltd., Mansion House Chambers, E.C. 3 (222,999). —Private. Sugar refiners and manufacturers, manufacturing and general chemists, etc. Nominal capital, £5000 in £1 shares. International Beet Sugar Corporation, Ltd., 56, Victoria Street, Westminster, S.W. 1 (223,233).—Public. To erect or acquire beet sugar factories or plants, works, or buildings connected with the beet sugar industry, etc. Nominal capital, £37,500 in 30,000 preference and 5000 ordinary shares of £1 and 50,000 deferred shares of 1s.

[1] *I.S.J.*, 1927, 145-150.
[2] *I S J.*, 1926, 633 [3] *S.A. Sugar J.*, 1927, 11, No. 6, 363.
[4] *The Times*, July 18th. [5] *Ibid.*, July 22nd. [6] *Ibid.*, July 26th.

Review of Current Technical Literature.[1]

The Misleading "Undetermined Loss" Figure: Manipulating the Sucrose Balance. **Hayward G. Hill.** *Facts about Sugar*, 1927, 22, No. 8, 182-183.

It has been found in certain quarters that by judicious deduction of some of the sucrose credited as coming into the house, the undetermined loss can be reduced to an insignificant figure. To-day it is a frequent thing in a certain country to see undetermined losses reported as low as 0·015 per cent. of the cane. If the amount of sucrose by direct polarization deducted to bring down the undetermined loss from say 0·200 to 0·015 per cent. were the only discrepancy in many reports, little damage would be done. As a matter of fact, an undetermined loss of 0·200 is not excessively high, nor does it necessarily indicate a considerable loss of sugar. But by the same method of adjusting figures the molasses loss can also be reduced, and this has been done in many factories, so that an actual loss of sugar involving many thousands of dollars over the season is hidden. This manipulation of figures is the most demoralizing influence that could possibly enter into chemical control, as the writer has pointed out in two previous articles,[2] leading in fact to a state of affairs in which the chemical control report is really manufactured on the calculating machine, and used as a kind of barrage to hide the poor work actually being done.

Following this the author demonstrates the position in the following way: Basing the chemical control on sucrose by direct polarization, the sucrose credited as coming into the house in the juice will differ by only a small amount from the true sucrose (as determined by the Clerget or double polarization method). But "even though levulose be absent or present in very small quantity in the juice, it always appears in large proportion in defecation-process molasses."[3] Such molasses consequently will often have a low direct polarization, and a very high sucrose number, the result being that the sucrose credited to the final molasses will be much less than that actually present in that product. This results in an amount of sucrose not being determined in the analyses, and the deficiency thus caused must go into the undetermined loss figure. Results from a factory, where a high degree of efficiency is shown, are now given, both on the customary apparent (direct polarization) and on the true sucrose (Clerget polarization) bases :—

Direct Polarization.—Table I.

	Tons.	Per Cent. on Cane.	Per Cent. Total Juice.
Sugar	6,426·535	11·607	90·224
Molasses	531·529	0·960	7·462
Press cake	13·969	0·025	0·196
Undetermined	150·833	0·273	2·118
Total juice	7,122·866	12·865	100·000

Clerget Polarization.—Table II.

	Tons.	Per Cent. on Cane.	Per Cent. Total Juice.
Sugar	6,443·868	11,638	89·735
Molasses	709·204	1·281	9·876
Press cake	14·083	0·026	0·196
Undetermined	13·809	0·025	0·193
Total juice	7,180·964	12·970	100·000

It is seen that on an apparent sucrose basis (Table I) the "undetermined" amounts to 0·273, whereas on true sucrose (Table II) it amounts to only 0·025, or a difference of 0·248 per cent. on cane. This difference is not an undetermined loss in the sense of an actual loss of material, but is an apparent loss only, and is entirely due to the fact that it is not possible to account for the sucrose properly in the

[2] *I.S.J.*, 1926, 382; 1927, 445.

[3] Spencer's "Handbook for Cane Sugar Manufacturers," page 136.

different products of a cane sugar factory when the report system is based on sucrose by direct polarization. Were the control based on true sucrose determinations, the theoretical undetermined loss, assuming no unknown losses of sucrose, mechanical or chemical, would be zero. In practice, on the true sucrose control, the difference between zero and the undetermined loss as shown would then represent actually the the unknown losses which had taken place. Such is not the case where the system of control is based on apparent sucrose determinations, for, assuming in this instance also, that there has been no undetermined loss of sucrose, mechanical or chemical, unaccounted for by the analyses of the products, the theroretical loss would not be zero, but an appreciable figure, which in this case is 0·248 per cent. on cane. Whereas in the former case we may look upon the undetermined losses which have actually taken place as being the difference between the reported undetermined figure and zero, in the case of the direct polarization control we must, in order to find the actual loss of sucrose which has taken place, chemical and mechanical, note the difference not between zero and the reported loss, but between the figure representing the difference due to the method of control, and the total reported figure, which in this case is the difference between 0·248 and 0·273. This fact may be further brought out by deducting enough sucrose in "Total Juice," Table II, to make the undetermined zero, and deducting the equivalent amount of sucrose by direct polarization in "Total Juice," Table I, and recalculating the balances, as shown in Tables III and IV following :—

DIRECT POLARIZATION.—TABLE III.

	Tons.	Per Cent. on Cane.	Per Cent. Total Juice.
Sugar	6,426·535	11·607	90·398
Molasses	531·529	0·960	7·477
Press cake	13·969	0·025	0·196
Undetermined	137·133	0·248	1·929
Total juice	7,109·166	12·840	100·000

CLERGET POLARIZATION.—TABLE IV.

	Tons.	Per Cent. on Cane.	Per Cent. Total Juice.
Sugar	6,443·868	11·638	89·908
Molasses	709·204	1·281	9·895
Press cake	14·083	0·026	0·197
Undetermined	0·000	0·000	0·000
Total juice	7,167·155	12·945	100·000

We now see that where a zero undetermined loss is shown in Table IV, the equivalent loss in Table III is not zero, but 0·248, although we are assuming in both cases that actually no material has been lost and unaccounted for. It is clearly to be seen that the undetermined loss of 0·248 in Table III is in no sense an actual loss of sucrose, but is an apparent loss only, due to a faulty system of control. With true

TABLE V.

	Tons Sucrose Apparent.	Tons Sucrose Clerget.	S.A. Per Cent. S.C.
Sugar	6,426·535	6,443·868	99·73
Molasses	531·529	709·204	74·95
Press cake	13·969	14·083	99·19
Total juice	7,122·866	7,180·964	99·19

sucrose at 100 per cent. Table V shows the percentage of sucrose by direct polarization as compared with its corresponding amount of true sucrose, the apparent sucrose and true sucrose in press cake being assumed to be in the same proportion as it is in the juice.

This custom of manipulating report figures is spreading, a point which is substantiated by stating that out of 83 factories reporting to a central organization in a certain country, 54 per cent. showed undetermined losses less than 0·050 per cent., and 84 per cent. showed less than 0·100 per cent. With little difficulty the use of enzymes for the determination of the true sucrose figure can be applied to factory control, and the results thus based on the true sucrose numbers.

An Economical Method of Refining Beet Raw Sugar for the Production of a Good White Grade. **Fr. Wilh. Meyer.** *Die deutsche Zuckerindustrie*, 1927, No. 19, 497-511.

Last year the author (who is factory manager at Wismar, in Meckl., Germany) carried out a number of experiments on the decolorizing of beet remelts, using, e.g., chlorine, hydrogen peroxide,, ozone, colloidal earths, lime and sulphurous acid, etc., finding all to give too costly a result. He, however, concluded that a sufficient decolorizing effect at an economic cost was obtainable by treating the remelt, firstly with lime and carbon dioxide, that is, by carbonating, and secondly by filtering through a layer of wood charcoal and "Carboraffin." Freshly precipitated calcium carbonate was found to exert quite a different effect on such remelt syrups than on raw beet juice, this unexpected result being ascribed to the higher purity and to the extremely fine granular condition of the precipitated $CaCO_3$, Starting with a liquor of 98° purity with a colour equivalent to 5° Stammer, and using only 1 per cent. of lime (calculated on the sugar), 50 per cent. of the colour could be removed by this treatment. But no improvement of the surface tension occurred, a condition that could only be brought about by the application of some decolorizing carbon or other, and all the known marks on the German market were tried, the two selected as the most suitable being "Carboraffin" and "Norit." Using 1 per cent. of lime and 0·2 per cent. of carbon the same decrease of colour and surface tension were obtained as with 0·5 per cent. of carbon alone, so that (the regeneration of the carbon not being considered) the use of the preliminary carbonation treatment represents a saving in cost. Experiments are cited showing that the two treatments, lime and CO_2 on the one hand, and carbon on the other, remove different colouring substances from the remelt. Those colouring substances removed by the lime can also be removed by thorough affining or washing in the centrifugals, but increasing the amount of lime above 1 say to 2 per cent. only increases the decolorization from 50 to 53 per cent. Carbon must therefore be used to give the necessary decolorization. A liquor of 99° purity, 60° Brix, and 2·5° Stammer, was rendered water-white with 0·5 to 1·0 per cent. of "Norit"; but in the case of remelts already carbonated having a higher colour than 4° Stammer, more than 1 per cent. of Norit would be required, and this relatively high addition would not be economical. Preferably, conditions should be adjusted to obtain a raw sugar remelt of 98° purity, 55-60° Brix, and 4-5° Stammer; then carbonation reduces the colour to half, and the carbon eliminates the rest. Plant required is as follows: a carbonating apparatus; three Dehne chamber filter-presses, each having 41 chambers of 0·5 sq. m. surface; three "Carboraffin" bag filters[1] each having 45 sq. m. filtering area; a centrifugal pump with motor and the necessary connexion. Then the procedure can thus be outlined: Middle and after-product sugars are affined to 98° purity, when the purity of the thick-juice or syrup is 93·5 to 94°; but raw beet sugars (e.g., those bought in from other factories) so long as they have a polarization of 96-97° do not require to be washed. The affined sugar or the raw sugar is melted to 55° Brix with thin-juice or with water, using a temperature of about 60°C. After passing through a rotating separator, the re-melt is limed until its alkalinity reaches 0·4 to 0·6 per cent. CaO at 60-70°C., the amount of the reagent added depending on the colour. Carbonation is carried out in two stages, the alkalinity in the first being reduced to 0·1 and in the second to 0·01 per cent. CaO, Filtration through the presses proceeds smoothly even at 60° Brix, though it is better at 55° Brix, at which degree work is rapid with the formation of very good cakes, but in the case of the very fine $CaCO_3$ it is necessary first to pump powdered wood charcoal into the presses in order to ensure a brilliant filtrate. With-

[1] "Kathol" system, made by Fritz Scheibler, of Elberfeld, Germany.

out being further heated, this filtrate is filtered through the carbon filters, which have previously been coated with ordinary wood charcoal and "Carboraffin," using 90 kg. of the former and 80 of the latter for a filter of 45 sq. m. surface. Now a liquor ready for concentration is obtained, and it is evaporated in the last body of the evaporator to 72-75° Brix, after which it goes to the pans, where it is grained on powdered sugar (using 12 grms. to every 15 tons of massecuite). Coming to cost figures, the following are given, and these are confirmed by Drs. BRENDEL and TÖDT of the Institut für Zuckerindustrie, Berlin :—In the 1926-27 campaign 333,888 ztr. (about 16,700 tons) of white sugar, the most part of it for export, were made, this realizing the same price as Czecho fine granulated, and the materials used in its production were as follows :—

59·4 ztr.	" Carboraffin " at 77·50 Mk.	4603·50 Mk.
2·0 ztr.	" Norit " at 42·50 Mk.	85·00 Mk.
68·9 ztr.	powdered wood charcoal at 5·35 Mk. ..	368·60 Mk.
1458·0 ztr.	Lime at 1·50 Mk.	2187·00 Mk.
	A total of	7244·10 Mk.

which per zentner (50 kilos., or 1 cwt.) of white sugar works out at only 2·19 pfennigs or only about 0·4 mark per ton of sugar made (which appears an extremely low figure). But even if the cost of the treatment were double that given, it would be relatively insignificant compared with the extra price obtained for the improved sugar on the English market, namely one shilling per cwt., as compared with the quality made in the previous year in the ordinary way.

DIFFICULTIES ATTACHED TO THE REFINING OF SUGAR BY THE OVERSEAS PRODUCER.
Fairrie & Co., Ltd., Liverpool. *In a Circular issued to the Trade.*

Messrs. Fairrie & Co., Ltd., Liverpool, issue a circular entitled " Sugar : the Inter-Relationship of the British Refiner and the Colonial Producer," in which it is submitted that " the home refiner is a necessity to the colonial sugar-producer." In proof of this there is brought forward a summary of the difficulties attached to the refining of sugar in the producing country. It is pointed out that the Hawaiian planters decided that the proper course to adopt was to have a refinery (at Crockett, near San Francisco, Cal., the largest in the world) that is in the consuming rather than the producing country ; that the American S. R. Co. own two of the largest mills in Cuba, and have recently built a refinery at Baltimore rather than refine at their mills; further that there are large refining companies in Australia and South Africa controlling numerous mills and preferring to bring their raw sugars to their refineries rather than refine at their mills. Messrs. Fairrie in their statement (which of course is an *ex parte* one) deal with the reasons that have influenced such decisions : (1) The difficulty of obtaining a plentiful and constant supply of pure fresh water for melting sugar or washing char in cane growing countries is obvious. (2) The bagasse would be insufficient fuel for char revivification and for the extra evaporations in refining. (3) A refinery must have easy access to the services of a number of firms specializing in the various sections of the engineering trade. Replacement of defective or worn-out plant must take place as soon as the trouble is observed. Stoppages due to some mechanical defect that cannot be foreseen are fatal unless the appropriate supplies and special manufacturing facilities are immediately and economically available. (4) Highly skilled workmen who are specialists in their business are required in a refinery. It would be difficult for them to be found easily in the cane growing countries, where neither constant employment nor attractive conditions could be offered to the whole of a refinery personnel. (5) Continuity of operation is essential. The importance of low costs is probably greater in sugar refining than in any other industry, owing to the minute margins with which refiners must work, with the result that their profits are dependent upon their weight-output reaching millions of pounds per day. The production of white sugar by a raw sugar factory necessitates either having a refinery which would handle all the raw sugar in six months, and lie idle for the remainder of the year, or the holding of stocks of raw sugar at the factory

sufficient to keep the refinery operating for the whole year. A refinery situated in the consuming country obtains its supplies of raw material from different countries, the periods of whose grinding seasons vary, and is therefore able to ensure a continuous supply of raw sugar.

In plantation refining the following difficulties are unavoidable: (*a*) The refiner, perhaps more than any other industrialist, must be in direct touch with the individual requirements of the buyers of his products; to give prompt consideration to any complaint; to assist, if necessary, in solving the technical difficulties of his customers. Above all the service regarding the transport and despatch of supplies must be perfect. If the refinery were situated in a distant country, a number of the services that the home refiner gives would not be available. (*b*) The atmospheric conditions in tropical climates cause rapid deterioration of sugar. (*c*) In transit from the factory, the bags are liable to be damaged and, in any case, a ship's hold, with its deep storage and high piling, is not an ideal warehouse for refined sugar. The possibility of water damage by rain or sea is an evil that often develops into an actuality—a point that the insurance companies will confirm. (*d*) To bring home the point of higher freight charges on refined than on raw sugar, the Atlantic trade may be cited. A reasonable figure for Cuban/U.K. freight would be say 17s. 6d. per ton. The corresponding figure for shipment from any of the U.S. Atlantic ports to the various U.K. ports would be 25 cents per 100 lbs., say 23s. per ton. (*e*) No one would wish to warehouse large quantities of white sugar, specially of the finer grades. Yet it is obviously desirable that large stocks of an essential commodity such as sugar would have to be carried. From the commercial point of view, the British refiner is of great value to the producer, for it is he who pays for the commodity immediately it reaches this country, and is thereafter responsible for the sorting, financing and marketing of it."

Error caused by Invert Sugar in the Determination of Sucrose in the Beet by the Hot Digestion Method. **Vl. Stanek and J. Vondrak.** *Zeitsch. Zuckerind Czechoslov.*, 1927, **51**, No. 23, 220-224. Owing to the action of the basic lead acetate, the invert sugar which may be present suffers a loss of its levo-rotatory power, and may even become dextro-rotatory, its cupric reducing power, however, being only slightly diminished. If the invert sugar present is considerable, then it is not exact (as is sometimes done) to correct the polarization by increasing it by one-third of the amount of invert sugar present. It is then necessary to determine the exact amount of sucrose present by double polarization, or else to determine the change in polarization of the invert sugar caused by the action of sodium hydroxide at the temperature of digestion.—Technical Experiments in 1925-26 with Different Activated Carbons (Carboraffin, Polycarbon, Supranorit 2, Supranorit 3, Superior Norit, Standard Norit and Anticromos). **A. Linsbauer and Jar. Fiser.** *Zeitsch. Zuckerind. Czechoslov.*, 1927, **33**, 353-368, 369-379. Layer filtration was used in filter-presses and mechanical filters, 2 kg. of each carbon were employed per sq. m. of filtering surface, the temperature 80 °C.; the rate of flow was 1 hectol. per sq. m. per hour; and the liquids treated were intermediate juice, thick-juice, and syrups. Using mechanical filters, it was possible to realize the following average decolorizations in 18-22 hours: Carboraffin, 40; Supranorit × 2, 39; Supranorit × 3, 44; Polycarbon, 39; and Superior Norit, 35 per cent. In the case of first syrups in scum presses in 19 hours, they were: Carboraffin, 32; Standard Norit, 29; Anticromos, 32·5; Polycarbon, 29, per cent.; and in that of the second syrup, Carboraffin, 14·7; Standard Norit, 16·5; Anticromos, 8·3; and Polycarbon, 4·6 per cent. A conclusive decision on the value of the various sorts of carbons examined could not be made. All carbons behaved well in the treatment of the syrups, though the prices of these, and their decolorizing power as tested in the laboratory, differed much from one another. Cheaper carbons should be used for the syrups, the amount should not be stinted, and revivification must be applied to make their use economical. In all cases continuous supervision was necessary and filter-presses cannot be recommended for layer filtration.—Urbain's Activated Carbon Process. **Edouard Urbain.** *Chimie et Industrie,*

1927, **17**, No. 4, 536-540. Cellulosic materials, sawdust or peat mixed with phosphoric acid solution into a homogeneous paste,[1] immediately react, resulting in the formation of a gel, a slight rise in temperature, the deposition of carbon, and the liberation in gaseous form of 3 to 4 per cent. of hydrogen, and, in smaller amount, water, methane, etc. If the carbon be calcined, considerable volumes of phosphoretted hydrogen are liberated; and the residue is active carbon which can be prepared for the market in different forms.—100° POINT OF THE SACCHARIMETER. **O. Spengler, C. Brendel and J. Schwirblianski.** *Zeitsch. Ver. deut. Zuckerind.*, 1927, 419-428. BATES and JACKSON,[2] KRAISY and TRAEGEL,[3] and other writers[4] have pointed out that the present specification for the establishment of the 100° point is in error, values of 99·895, 99·834, and even a little less, having been found. JAECKEL[5] has suggested that the reason for this may be the adsorption of air by the finely divided sugar, a less amount of sugar being actually weighed than presumed. This theory has now been put to the test by dissolving very finely divided sugar in an flask connected with a very sensitive capillary gauge for indicating very minute alternations of volume in the flask, 17·35 grms. of sugar during solution in 18·5 c.c. of water producing an increase of volume equal to 0·999 c.c., or 5·76 c.c. for 100 grms. (taking into consideration the contraction arising on solution), equivalent only to 7·0 mgrm., an amount incapable of affecting the result. It is therefore concluded that this explanation of the source of error will not suffice.—COMPARATIVE INVESTIGATIONS ON THE ADSORPTION OF ACTIVATED (DECOLORIZING) CARBONS. **O. Spengler and F. Landt.** *Zeitsch. Ver. deut. Zuckerind.*, 1927, 429-473. Two solutions were used, viz., 25 per cent. beet molasses, and a liquor made by dissolving an affined beet after-product sugar to 50° Brix (the *pH* in both cases being about 8·6), the procedure being to keep the liquid in contact with different weights of the various carbons during 35 mins., at 90° C., and to measure the colour by means of a König-Martens polarization spectro-photometer. Average "times better than Standard-Norit" arrived at for the molasses solution were as follows: Superior-Norit, 1·1; Eponit-special, 1·6; Supra-Norit × 2, 1·6; Carboraffin, 2·7; Supra-Norit × 3, 3·2; Supra-Norit × 5, 4.6 In the affined sugar liquor, the carbons came out in the same order; but, calculating the amount of carbon used on the non-sugar present in the solution, and comparing the molasses with the affined sugar series, it was found that in the latter purer solution, the decolorization was much behind that effected in the molasses solution, the reason for this being the rôle played by the sugar. Surface tension determinations produced such erratic results that it was impossible to utilize them.—CRYSTALLIZATION OF SUGAR FROM STRONGLY SUPERSATURATED SOLUTIONS. **K. Sandera.** *Zeitsch. Zuckerind. Czecho.*, 1927, **51**, *No.* 36, 401-412. Mr. STANEK had noticed that very pure solutions of sugar fail to crystallize even after a long time after being allowed to evaporate quickly at a low temperature, this observation having originated from the spilling of sugar juice on the stone-plate of a fume-cupboard, where in winter it became rapidly cooled, and where in the current of air it became concentrated. but without its crystallization taking place. Using specially designed apparatus, Dr. SANDERA proved that crystallization in strongly supersaturated solution begins only when the temperature of the solution exceeds a certain limit. A definite range of temperature exists, within which crystallization is capable of taking place, this range being controlled on the one hand by the temperature at which the solution ceases to be supersaturated, and on the other by the temperature corresponding to the viscosity at which crystallization can begin. This range in practice is controlled, however, by the composition of the solution, i.e., its content of positive and negative molasses-forming constituents which affect the solubility and therefore the saturation of the solution. It follows that sugar cannot crystallize from any solution whose saturation or supersaturation arises at temperatures at which the viscosity reaches a limit inhibiting crystallization.

J. P. O.

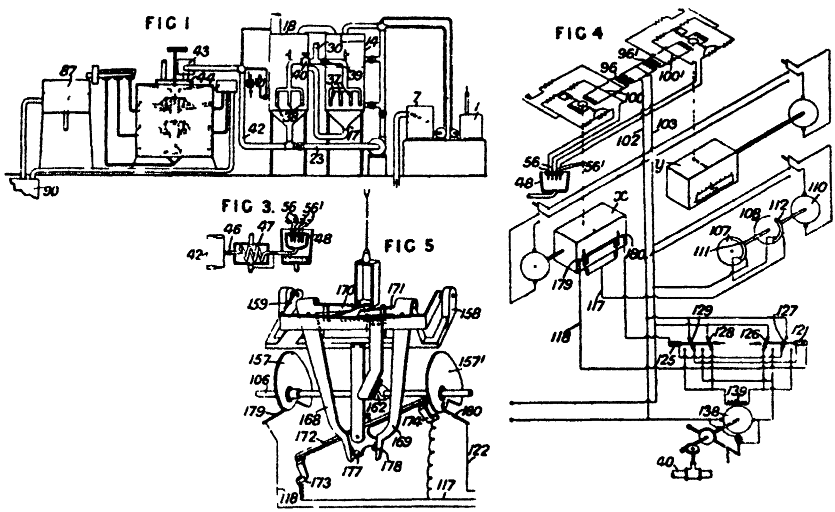
[1] See Urbain's Patents, *I.S.J.*, 1926, 621, 678, and elsewhere.
[2] *I.S.J.*, 1917, 380.
[3] *I.S.J.*, 1922, 156; 1924, 501.
[4] *I.S.J.* 1921, 588, 646; 1926, 164.
[5] *I.S.J.*, 1923, 495.

Review of Recent Patents.[1]

UNITED KINGDOM.

Control of Clarification (e.g., in the Carbonation Process).* **Dorr Co.**, of 247, Park Ave., New York, U.S.A. (assignees of **E. R. Ramsey**, and **A. W. Bull**). 270,757. May 9th, 1927; convention date, May 8th, 1926.

In controlling the purification of sugar juices, when employing for example milk-of-lime and carbon dioxide gas, the alkalinity of the treated juice is determined in relation to the electrical resistance of a portion of the juice in which dissolution and reaction are completed. The rate of feed of a treating agent in the purification process is controlled automatically or manually in accordance with the variations in electrical resistance produced, and the regulation is effected intermittently in order that the juice condition may become stabilized after each treatment. The feed of carbon dioxide gas to the limed juice is automatically controlled and preferably, the regulation is effected at the last carbonation tank. As shown, Fig. 1, milk-of-lime and beet juice are pumped respectively from tanks 1, 7 to the top of the first carbonation tank 14 and from this tank by way of outlet 17 to the second carbonation tank 18, part of the juice being recirculated through pipe 23. The carbon dioxide gas is supplied through pipe 30 and valves 39, 40 to perforated branchings 37, 38 at the bottom of the carbonation tanks. The discharge pipe 42 passes through a heater 43 and into the clarifier 44 which may be of the Dorr tray type, the sludge passing to a filter 87 which discharges into the clear juice tank 90. The resistance measuring



device, Fig. 3, comprises a vessel 48 containing a portion of the treated juice passed from the discharge pipe 42 by way of pipe 46 and steam chamber 47. The vessel 48 contains two pairs of electrodes 56, 56^1 connected respectively to a controlling galvanometer and a recording galvanometer *y*, Fig. 4, through Wheatstone bridge circuits 100, 100^1 fed by transformers 96, 96^1 from the mains 102, 103. The construction of the recording and controlling galvanometers is similar, the record being made either by scale or graph. The controller portion of galvanometer *x* comprises a frame 159 rocked by a cam 162 on a motor shaft 106 which also carries contact cams 157, 157^1 connected by brushes 179, 180 with lines 118, 122. Lever arms 168, 169 pivoted to a fixed frame 158 are provided with extensions 170, 171 between which the galvanometer needle is reciprocated by the rocking-frame 159. A rocking-bar

[1] Copies of specifications of patents with their drawings can be obtained on application to the following—*United Kingdom*: Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price 1s. each). Abstracts of United Kingdom patents marked in our Review with a star (*) are reproduced from the *Illustrated Official Journal* (*Patents*), with the permission of the Controller of H.M. Stationery Office, London. Sometimes only the drawing or drawings are so reproduced. *United States*: Commissioner of Patents, Washington, D.C. (price 10 cents each). *France*: L'Imprimerie Nationale, 87, rue Vieille, du Temple, Paris *Germany*: Patentamt, Berlin, Germany.

172 is provided with pins 177, 178 engaged by the lever arms 168, 169 and also carries brushes 173, 174 connected in line 117. As the alkalinity of the juice varies, the galvanometer needle is caught and held for a longer or shorter period between the extension 170 of 171 and the rocking-frame 159. The lever arm 168 or 169 tilts and rocks the bar 172 engaging either brush 173 or 174 with the contact disc 157 or 157^1. Depending upon which contacts have been made, current is supplied through solenoids 121, 125 to operate switches 126 . . . 129 for closing the armature and field circuit 129 of a reversible motor 138 operating the carbon dioxide valve 40. In order to provide that the juice condition is stabilized after each treatment, the line circuit 117 to the controller is periodically iuterrupted by insulation cams 107, 108 driven by a motor 110 and provided with contact segments 111, 112.

PRODUCTION, APPLICATION, AND REVIVIFICATION OF ACTIVATED (DECOLORIZING) CARBON. (*A*) **Verein für Chemische und Metallurgische Produktion,** of Aussig-on-Elbe, Czecho-Slovakia. 264,799. November 16th, 1926; convention date, January 22nd, 1926. (*B*) **W. J. Smit,** of Oudenbosch, Holland. 264,854. January 20th, 1927; convention date, January 23rd, 1926. (*C*) **Verein für Chemische Industrie A.-G.,** of Frankfort-on-Main, Germany. 265,916; addition to 259,616. February 15th, 1927. (*D*) **Chemische Werke Carbon Ges.,** of Ratibor, Germany. 266,673. November 29th, 1926. (*E*) **Chemische Werke Carbon Ges.,** of Ratibor, Germany. 266,674. November 29th, 1926.

(*A*) Exhausted, pulverulent, decolorizing carbon is re-activated by agglomerating the wet material into pieces of suitable shape without the use of a binder, igniting and finally washing with water, hydrochloric acid, etc. During the latter treatment the particles again break up into a fine powder. (*B*) Adsorption charcoal which loses its adsorptive properties on drying, storing, etc., is rendered stable or restored by treatment with lyes, salts, gases or vapours, either separate or combined. Alkali or alkaline earth lyes or salts in the form of solids or solutions are used and the gases employed include chlorine, sulphur dioxide, oxygen, carbon dioxide, ordinary combustion gases and steam. The stabilizing agent, or the charcoal, or both, may be treated, and high temperatures, graduated up to 1000° C., are used. In an example, the charcoal is saturated with a dilute calcium chloride solution, excess of the solution being removed, and heated to 300-700° C. After grinding and drying the charcoal is ready for use. (*C*) Activation of carbon by means of oxygen diffused through the walls of the treatment chamber in accordance with the process of the parent specification[1] is effected in spaces of narrow dimensions in order to increase the contact between the oxygen and the carbon. The chambers, which may be heated externally by means of furnace gases may be provided with internal channels for the passage of oxygen, or gases containing oxygen. The diffusion gases may be preheated, and the diffusion effect facilitated by the direct passage through the retort. (*D*) Active carbons in the form of blocks or granules having the properties set forth below may be prepared, for example by the process of specification 266,674 (following). The compounded carbon may have a hardness of 10-40 Shore or more and when in a 1 litre measuring cylinder may withstand a pressure of 4 kgs. per cm.^{2} without fracture. A cylindrical grain having a diameter and depth of 4 mm. may, however, have a resistance to breaking of 200-800 kgs. or more per cm.^{2} It may be revivified by means of steam, acids, lyes, oxidizing or reducing agents and by ignition. Factors that are of importance in the formation of the agglomerates include the degree of fineness of the raw material, the nature of the organic or inorganic binder, the presence of inorganic substances, the high pressure during moulding and the manner of drying, carbonization, calcining and activation. Silica gel is mentioned as an inorganic binder. (*E*) Hard blocks or granules of active carbon are produced from finely divided carbon or carbonizable material by mixing it with an organic binding medium and moulding the mixture under pressure, drying, carbonizing, calcining and finally activating. An inorganic substance, for example sodium or other hydrate, phosphoric or other acid, or salts such as carbonates, bisulphates, zinc or other chlorides, or

[1] *I.S.J.*, 1927, 47.

sulphites may be added to the binder to activate the product. Sulphite cellulose lye is a suitable binder as it already contains inorganic salts. The carbon which may have been previously activated may be impregnated with inorganic substances before being mixed with the binder. Wood-tars are also mentioned as suitable binders, the inorganic salts or their solutions being emulsified or otherwise impregnated therewith when necessary. The blocks, etc., are dried preferably in an oxidizing atmosphere, e.g., by means of hot air and a catalyst added, which will facilitate oxidation, such as a siccative. Carbonization is effected with or without the introduction of a gas such as air or even steam, and the blocks, etc., are preferably maintained in motion. After carbonization, the carbon is calcined in the absence of air and is then activated by known processes, e.g., by means of steam in a rotary furnace. Finally, the carbon is washed with water, hydrochloric or other acid or with alkalies. It can be revivified by means of acids, alkalies, oxidizing or reducing agents or gases.

PRODUCTION, REVIVIFICATION, AND APPLICATION OF ACTIVATED (DECOLORIZING) CARBON. (*A*) **Darco Sales Corporation,** of New York (assignees of **P. Mahler**). 269,469. June 18th, 1926; convention date, April 15th, 1926. (*B*) **Soc. de Researches et d'Exploitations Petrolifères,** of Paris. 269,477. November 23rd, 1926; convention date April 15th, 1926. (*C*) **E. Urbain,** of Paris. 269,961. January 20th, 1926.

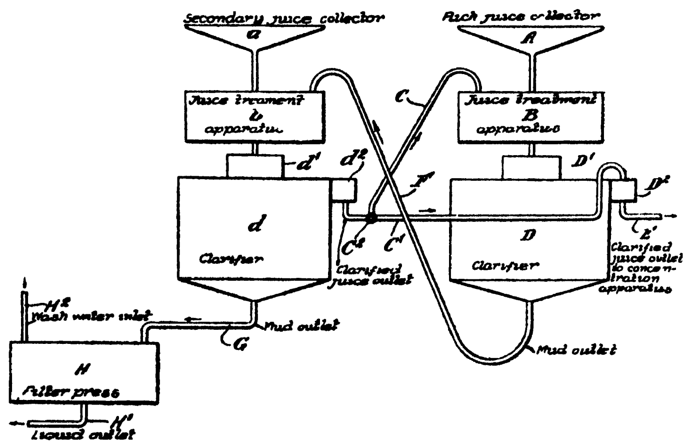
(*A*) Decolorizing agents such as active carbon and other purifying agents for liquids are re-activated in a wet or pasty state under ordinary conditions of temperature and pressure by means of a gas such as chlorine or sulphur dioxide, the passage of the gas through the spent material being preferably continued until bubbles appear on its surface and may be preceded by the usual washing treatment. (*B*) Apparatus is described for the treatment of carbonaceous materials with activating gases at high temperatures in vessels or chambers having slightly permeable walls, any known activating gas being used, together with steam, carbon dioxide, chlorine, oxygen, etc., and the speed of action varied by varying the dilution of the gas. (*C*) In order to produce an agglomerated active carbon which will have high activity with regard to a particular gas or group of gases, the density of the final product is controlled. This is effected by varying the pressure applied during the moulding or extrusion of the plastic mass formed from the pulverized carbon by means of a suitable binder in the usual manner, or by varying the proportion of water in the mass, the shaped masses being finally calcined and, if necessary, washed. (Reference has been directed by the Comptroller to Specifications 218,242 and 247,241.)

METHOD FOR THE PREVENTION OF THE CORROSION OF CONTAINERS FOR ALCOHOL MIXTURES. **U.S. Industrial Alcohol Co.** (assignees of **W. T. Schreiber**) 269,135. December 1st, 1926; convention date, April 6th, 1926. To prevent corrosion of containers for alcohol, alcoholic solutions or mixtures such as denatured alcohol, carbon removers, motor fuels, primers for internal-combustion engines and anti-freeze liquids, soap or soap-forming materials such as the higher fatty acids which are soluble in the alcoholic liquid, are dissolved therein. Preferred soaps are the soluble alkali soaps formed from the higher fatty acids such as palmitic, stearic or oleic acid, but any of the ordinary soaps or rosin soap may be used. Amount of soap may vary from traces up to an amount sufficient to form a saturated solution of the liquid. This invention is particularly useful for denatured alcohol containing water, wood alcohol, pyridine, hydro-carbons, ether, acetone, esters, nitrobenzene or other impurities or denaturants. It is presumed that a protective layer of insoluble soap is formed with the metal of the container.—PREVENTING THE CAKING OF ICING SUGAR. **A. Ackers,** of Homebush, near Sydney, Australia. 270,822. February 16th, 1926. To prevent caking, icing sugar is cooled after milling and before packing to remove the heat generated in the crushing mill. Air cooling may be employed, the sugar being placed in chambers which may have means for circulating the air. With large outputs, the sugar may be cooled during continuous conveyance between the mill and the packing platform. After cooling, the sugar may be dressed or reconditioned by sieving etc.

UNITED STATES.

Recovering Sugar Content in Cane Juices. **Cuthbert G. Petree** (assignor to **Petree & Dorr Engineers, Inc.,** of New York). 1,625,680. April 19th, 1927.

The invention consists in a novel method of separating the sediment or mud from the richer and more dilute juices obtained from the primary and secondary sections of the cane juice milling circuit; and is characterized by the steps taken to reduce the richness of the sugar juices forming the juice vehicle admixed with the solids and semi-solids forming the mud or sediment passing to the filter-press, and by the relatively open and granular character of the filter-press cake produced in consequence of the special manner in which the mud is separated from the clarified sugar juices, and by the double treatment with chemicals and/or heat to which the more dilute juices are subjected in the process. In the drawing, *A* represents the primary rich juice collector underlying the primary section of a cane milling circuit, and *a* is a secondary collector receiving the more dilute juice produced by maceration with water or dilute juices expressed from the cane in the later stages of the milling circuit. The rich raw juice from the collector *A* passes to a treatment apparatus *B* which also receives through the conduit *C* the secondary juice after the latter has been preliminarily clarified, as hereinafter explained. The juice mixture thus passing to the apparatus *B* is subjected therein to a chemical action or to a heating action, or



preferably in most cases to both actions, to coagulate albuminoids and to give the proper acidity or alkalinity to the clarified juices separated from the sediment in the clarifier *D* to which the juices pass through the inlet or feed chamber D^1. The clarifier *D* may be a Dorr decanter, or of other suitable type, and is provided with a clear juice outlet or collecting chamber D^2 from which the clarified juice passes through a conduit *E* to the concentration apparatus. The mud separated from the juice in the clarifier *D* is passed from the bottom of the latter through the conduit *F* to the treatment apparatus *b* which receives the raw secondary juice from the secondary juice collector *a*. In the apparatus *b* the mixture of raw secondary juice with the mud from the clarifier *D* is subjected to suitable chemical and/or heat treatment. The mixture of secondary juice and primary mud then passes to the feed or inlet chamber d^1 of a clarifier *d* of suitable type, and ordinarily similar to the clarifier *D*. The clarifier *d* is provided with a clear juice chamber d^2 from which the clarified juices pass through the conduit *C* to the treatment apparatus *B*. The sediment separated from the juice in the clarifier *d* passes from the bottom of the latter through the conduit *G* to the filter-press *H* which may be of any usual and suitable type, H^1 and H^2 conventionally representing the liquid outlet and wash water inlets, respectively, of the filter-press. The juices extracted from the mud in the filter-press *H* can be utilized in any usual or suitable manner, and in particular, can be returned

to the milling circuit for use as maceration liquid with the ultimate recovery of their sucrose content from the juice passing into the secondary juice collector *a*, or can be added to the juice mixture treated in the apparatus *b*. A number of important advantages are thus obtained, which may be summarized as follows:—The amount of sugar content in the mud passing to the press is reduced, and its extraction in the press is facilitated. The double decantation tends to the production of a cake of a desirably open granular form. The whole of the clarified juice is ultimately delivered to the concentration plant from the primary clarifier *D*, and the chemical treatment of the juices in the apparatus *B* can therefore be controlled to give the best clarifying effect, thus best fitting the juice to boiling-house requirements. The mud is finally collected under the conditions most favourable for the preparation of a cake initially low in sugar and of a granular and relatively stable nature. With the character of the mud thus produced, a relatively small amount of wash-water, and indeed in some cases no wash-water at all, need be supplied to the filter-press.

PRODUCTION, REVIVIFICATION, AND APPLICATION OF ACTIVATED (DECOLORIZING) CARBONS. (*A*) **Edgar R. Sutcliffe**, of Leigh, Lancs. 1,629,237. May 17th, 1927. (*B*) **Heinz Thienemann** (assignor to **I. G. Farbenindustrie**, of Frankfurt a. M., Germany). 1,638,070. August 9th, 1927. (*C*) **Alfred Oberle**, of Oak Park, Ill., U.S.A. 1,632,845. June 21st, 1927.

(*A*) A method of producing an activated coke consists in reducing coal to a substantially uniform condition of fineness, then compressing the coal into blocks without the addition of any binder and without the addition of any non-carbonaceous substance, to produce a stone-like block, then coking the block and then activating it, substantially as described. (*B*) In a carbonization process in which the carbonaceous material is continuously moved through the carbonizing furnace throughout the period of carbonization, the carbonaceous material of adhesive or pasty characteristics is prevented from adhering to the furnace walls by feeding such carbonaceous material to the furnace in the form of compressed, moulded charges. (*C*) A process for producing carbonaceous material, consisting in heating a carbon resulting from the destructive conversion of hydrocarbons under temperature and pressure conditions in the presence of moisture to drive off the volatile material, subsequently imposing a vacuum action while maintaining the carbon in a highly heated state and treating the resultant carbonaceous material with an acid to remove remaining impurities.

IMPROVEMENTS ON BEET HANDLING APPARATUS. **George W. Yanney** (assignor to **The Alliance Machine Co.**, of Alliance, Ohio, U.S.A.). 1,632,574. June 14th, 1927. An apparatus of the class described, comprising a movable hopper, a plurality of discharging gates carried thereby, a counterweight for holding said gates in closed position when the hopper is empty, a manually controlled automatically released brake co-operating with said counterweight to hold the gates in closed position when the hopper is loaded, and flexible tension means intermediate said brake and said gates, substantially as described. LIME KILN. **Arthur E. Truesdell**, (assignor to **Doherty Research Co.**). 1,627,215. May 3rd, 1927. A lime kiln in combination with the vertical kiln, of a furnace is arranged to burn fuel under conditions to produce products of combustion at a temperature in excess of that required for the efficient burning of limestone and to deliver such products of combustion to the kiln, also means to withdraw waste gases from the kiln and introduce them into the furnace between the point where the combustion takes place and where the products of combustion are delivered to the kiln.—PRODUCTION OF CANNERY SYRUP. **Eugene S. Cochran** (assignor to **John T. McCrosson**, of Honolulu, T.H.). 1,606,827. November 16th, 1926. Raw juice is strained without liming or other treatment, forced through a closed heater at a temperature above boiling point, and at a pressure of 20-30 lbs. per sq. in., conducted through a filter-press under substantially the same pressure, after which it is "refined and decolorized," re-filtered, and concentrated to the desired density. In the refining and decolorizing

process, infusorial earth (½ per cent.) and decolorizing carbon or bonechar (about 1 per cent.) are used.—REVIVIFICATION OF SPENT FILTERING MEDIA (KIESELGUHR ETC.). **Stanley Hiller,** of San Francisco, U.S.A. 1,598,967. September 7th, 1926. Broadly the process comprises initiating combustion of the combustible and carbonaceous materials contained in the spent materials by the application of heat, and when the carbonaceous material is ignited, propagating combustion or burning out thereof by causing and allowing a combustion supporting gas to intimately contact with the ignited mass. The degree of removal of carbonaceous material from the pores of the filtering material is controlled and regulated by regulating the supply of combustion supporting fluid to the ignited mass. In this manner the porosity of the revivified product is controlled and brought to a desired degree.—DESTRUCTIVE DISTILLATION OF VINASSES (DISTILLERY SLOPS OR SPENT WASH). **Gaston P. Guignard,** deceased, late of Melun, France. 1,609,712. December 7th, 1926. A process for the destructive distillation of vinasses under vacuum and in the presence of moisture, comprising gradually and continuously introducing moisture, during the entire period of the destructive distillation, into the heart of the mass being distilled, and continuously agitating the mass during distillation at a temperatire of about 450 to 650°C.—A COLORIMETRIC HYDROGEN-ION CONCENTRATION APPARATUS AND METHOD. **Eugene D. Stirlen,** of Muscatine, Iowa, U.S.A. 1,616,092. February 1st, 1927. Claim is made for the method of testing a translucent solution to determine its hydrogen-ion concentration, which comprises utilizing a prism unit having two overlapping wedge-shaped prisms, each of which has a colour corresponding to known hydrogen-ion concentrations, placing a portion of the translucent solution adjacent to the prisms, dissolving another portion of the translucent solution in a chemical indicator of known concentration, placing the dissolved solution adjacent to the prisms, passing a beam of light through said translucent test solution and the prisms, passing a second beam of light through the dissolved solution, and moving the prism unit with respect to the solutions until an equal colour intensity in each beam is obtained.—WORKING SUGAR CANE. **Albert E. Kienzle,** of Cairo, Egypt. 1,633,895. June 28th, 1927. A process of treating sugar cane comprises reducing the cane to flour and dividing the flour into a plurality of grades with respect to sugar content by sifting.—TREATING LIQUIDS IN PRESENCE OF ACTIVE CARBON. **Cornelis Lourens** (assignor to the **General Norit Co.,** of Amsterdam, Holland). 1,634,154. June 28th, 1927. In a process in which a gaseous agent is caused to act upon a liquid material, the step of subjecting the liquid material to the action of gas in the presence of active carbon.—MANUFACTURE OF BETAINE HYDROCHLORINE. **Donald K. Tressler** (assignor to the **Larrowe Construction Co.,** of Detroit, Mich., U.S.A.). 1,634,221; 1,634,222. June 28th, 1927. In the first patent hydrochloric acid is added to the cool solution, thus precipitating betaine hydrochloric and inorganic chlorides and the remaining solution subsequently heated to precipitate the glutamic acid as glutamic acid hydrochloride. In the second specification to concentrated residual liquor one adds concentrated sulphuric acid and a chloride of a metal forming an insoluble sulphate, with the resulting production in the liquor of hydrochloric acid and the insoluble metal sulphate.—PRESERVATION OF CANE JUICE. **Arnold K. Balls,** of Philadelphia, Pa., U.S.A. 1,634,348. July 5th, 1927. The process of preserving sugar cane juice for subsequent use in growing yeast which comprises inoculating the material with lactic acid forming micro-organisms, and keeping the acidifying liquid at a temperature of substantially 55°C.—PAPER PRODUCTION FROM STRAW, ETC. **Charles D. Wood** (assignor to the **Grasselli Chemical Co.,** of Cleveland, Ohio, U.S.A.). 1,634,603. July 5th, 1927. Process of making paper from straw and similar fibrous vegetable materials, comprises incorporating the alkali-soluble components of the fibrous material obtained by digesting the fibrous material with an alkaline reagent comprising a soluble sulphide with a pulp derived from said fibrous material.—BEET HARVESTER. **Jean Moreau,** of Noyelles-sur-Escaut, France. 1,635,494. July 12th, 1927. In a beet harvester, means are provided to travel over the beets, a rotary knife lifted by said means to the crown of the beet, rotating means to remove the cut tops from the knife, a conveyor, and a guide between the conveyor and said rotating means to direct the tops to the conveyor from said rotating means .

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1927. Tons.		1926. Tons.
Total Receipts, January 1st to Aug. 31st	2,217,546	..	2,414,915
Deliveries „ „	2,198,727	..	2,242,551
Melting by Refiners „ „	2,153,598	..	2,238,000
Exports of Refined „ „	67,000	..	68,326
Importers' Stocks, August 31st	133,681	..	181,020
Total Stocks, August 31st	224,527	..	234,849
	1926.		1925
Total Consumption for twelve months	5,671,335	..	5,510,060

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1925, 1926, AND 1927.

(Tons of 2,240 lbs.)	1925 Tons		1926. Tons		1927 Tons
Exports	3,440,894	..	2,756,843	..	2,591,791
Stocks	970,025	..	1,195,658	..	998,210
	4,410,919	..	3,952,501	..	3,590,001
Local Consumption	87,000	..	80,000	..	81,000
Receipts at Ports to July 31st	4,497,919	..	4,032,501	..	3,671,001

Havana, July 31st, 1927. J. GUMA.—L. MEJER

Sugar Crops of the World.

(Willett & Gray's Estimates to September 1st, 1927.)

	1926-27. Tons.		1925-26. Tons.		1924-25. Tons.
CANE.					
America	8,303,541	....	8,665,210	....	8,877,329
Asia	6,235,800	....	6,309,189	....	5,661,027
Australasia	500,611	....	592,911	....	536,490
Africa	635,474	....	668,514	....	545,260
Europe	7,500	....	8,704	....	7,661
Total Cane	15,682,926	....	16,244,528	....	15,627,767
BEET.					
Europe	6,823,236	....	7,440,367	....	7,083,068
U.S.A	801,246	....	804,439	....	974,185
Canada.............	28,250	....	32,475	....	36,200
Total Beet	7,652,732	....	8,277,281	....	8,093,453
TOTAL CANE AND BEET....	**23,335,658**		**24,521,809**		**23,721,220**

United Kingdom Monthly Sugar Report.

Our last report was dated 11th August, 1927.

The London market generally has maintained a steady undertone, but this has been brought about by the firm markets in America, and although London has not followed the advance in New York to the same extent, prices have generally hardened.

The Terminal market was chiefly concerned until the end of August, with the liquidation of that month, and it was not until the last two days that any quantity of sugar was delivered. There were roughly 20,000 tons tendered at the end of the month, and Bulls who expected a squeeze were forced to take up this sugar, which consisted chiefly of TATE's Granulated. August at one time touched 16s. 6d., but fell on the tenders to 15s. 9d., finally closing at 15s. 10½d. There have not been large dealings in September, but the price has remained steady at about 15s. 9d. Large Continental covering orders have come into the market for October/December, and the 1927 months, and prices have been driven up to 15s. 4½d. for December, 17s. 6d. March, 17s. 8¼d. May, and 17s. 10½d. August. The latest prices are September 15s. 9d., October 15s. 4½d., December 15s., March 16s. 11¼d., May 17s. 2¼d., August 17s. 4½d.

The demand for White Sugar has never been very active during the period under review, the Trade only buying their immediate requirements in view of the discount on forward months. Ready Granulated sold from 17s. 1½d.-17s. 4½d. f.o.b., whilst November/December sold from 15s. 1½d.-15s. 7½d. The Spot market has remained steady, and Spot Granulated sold from 29s. 9d. to 29s. 3d.-29s. 7½d. The stock in London is still small, and the imports of fresh sugar are practically nil. The Home Grown factories have made a start with the marketing of their production, and have made considerable sales of October/December delivery.

The British refiners have been doing a good proportion of the business, but have only shown an advance of 3d. per cwt. on the month. At the latter end of August they made considerable sales of forward deliveries, selling at one moment as low as 29s. for October, and 28s. for November/December, but they have since advanced their prices by 1s. to 1s. 6d. per cwt. Their latest prices are TATE's No. 1 Cubes 34s., London Granulated 31s. 1½d., November/December 29s. 6d.

Raws have been quiet, but a considerable business was done in Cubans to the British refiners during August at 13s. 3d. c.i.f. The price to-day however, has been advanced to 14s. 3d.

In America, the possibility of a restriction scheme for the next Cuban crop has caused heavy covering of paper, and also started a fresh Bull campaign for speculators. The latest advices are that the President intends to recommend to Congress the limitation of the production next year, and a Committee of five experts is to be appointed to recommend the size of the crop. It is further suggested that an endeavour is being made to reach an agreement with five of the largest producing countries in the world to regulate the world's production. It has been rumoured that the next crop is to be limited to 4,000,000 tons, 150,000 tons of which would be earmarked for home consumption, 3,500,000 tons for the United States, and the balance of 350,000 tons for export to outside countries. Cubans have advanced from $2\frac{7}{8}$ to $3\frac{1}{16}$, and the Futures market has gained from 25 to 35 points.

The latest estimated of the Java crop is 2,330,000 tons, and it is reported that the sowings for the next crop are to be increased by 15 to 20 per cent.

Weather on the Continent has turned hot and fine, which is distinctly favourable for the growing crops. Mr. F. O. LICHT's fifth estimate of the acreage sown is 2,507,000 hectares, against 2,171,415 hectares last year. The crop is expected to be in the neighbourhood of 8,000,000 tons.

21, Mincing Lane,
London, E.C.3.
9th September, 1927.

ARTHUR B. HODGE,
Sugar Merchants and Brokers.

THE

INTERNATIONAL SUGAR JOURNAL.

☞ All communications to be addressed to "The International Sugar Journal," 2, St. Dunstan's Hill, London, E.C. 3.

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed

No. 346. OCTOBER, 1927. Vol. XXIX.

Notes and Comments.

Sugar Control Legislation in Cuba.

Since our brief reference last month to the intentions of the President of Cuba to pass fresh legislation to control the Cuban output of sugar and endeavour to get some measure of co-operation from other big sugar producing countries, matters have progressed rapidly at Havana, and it is announced as we write these lines that both Houses of the Cuban Congress passed on October 4th what is to be known as the Sugar Defence Bill. It bears out the forecasts published a month ago that the President was to appoint a special Commission of five experts (not necessarily Cubans) to assist him in studying the problem of sugar restriction each year and recommend to the President the size of the crop to be authorized. This Commission is intended to be permanent but is not salaried ; each Autumn it will give particular attention to the extent of the World Stocks, Production, and Consumption, and the estimated requirements for consumption of Cuba, the United States, and other countries likely to need Cuban sugar. On receipt of its report the President will determine not later than November 30th the total amount of sugar to be made in Cuba the following grinding season and its proper distribution in (*a*) Cuba, (*b*) the States and (*c*) Other Countries. All the sugar exported other than that apportioned to go to the U.S.A. is to be handled by a newly created Sugar Export Corporation which will attend to the sale, shipment and distribution of what is to be termed "Cuban Over-production." To this Corporation all the producers concerned will have to subscribe pro rata to their production, which probably means about 1 cent per bag, the proceeds of which money will form the capital stock of the Corporation. Besides deciding the proportions in which the sugar crop shall be sold, the President will declare the percentage allowable to each producer. Producers will be allowed to dispose on their own of their proper share of the quantity apportioned to be exported to the United States. Incidentally, the Export Corporation is to take over the sugar at present lying unsold in Cuban warehouses, to any amount not exceeding 150,000 tons.

This covers in substance the provisions of the new law as it will affect Cuban production. But we gather that the law will also authorize the

creation of Commissions to negotiate co-operative measures of sugar control with other countries such as Java, Hawaii, the Philippines, and Santo Domingo. Negotiations with the last named country are already reported in the press.

The Objects of the New Legislation.

The broad aim of the Cuban President is, he has stated, to ensure as far as possible the stability of the Cuban sugar industry and obtain for its production a reasonably remunerative price for all concerned. This postulates amongst other things a steadier relation between world production and consumption. But there are a good many " ifs " in the plan. The feeling in the United States seems to be that Cuba hopes by restricting her output, and thereby the proportion of her sugar that shall go to the United States, to make the latter pay the whole of the 20 per cent. preference in the tariff (0·44 cent per lb. commonly called 44 points) to the enrichment of the Cuban producer, instead of the 25 to 30 points that would appear to be the ruling difference. It is argued that the establishment of an Export Corporation in Havana can only mean that one price is to be charged to the States and another—possibly much lower if inducement offers—to those markets that take the Cuban over-production. If this eventuates, then the question of continuing the Preferential Duty on Cuban sugars entering the United States may conceivably become a live issue. Under the existing law it can be abrogated at any time on twelve months' notice being given. American selling and consuming interests might well take strong exception to this Cuban interpretation of the Preference Tariff, for if Cuba is allowed to pocket the whole of the 44 points, the U.S. consumer, it is pointed out, would have to pay nearly half a cent per lb. more for all his sugar—not only Cuban but Porto Rican, Philippine, and Domestic Beet—for the reason that the price of all the rest of these sugars is made by the Cuban sugar price.

Opinions so far expressed differ as to the wider consequences of this new legislation, especially if the coming Cuban crop is restricted to four million tons. One German authority[1] who surveys the possibilities points out that the chief danger for Cuba seems to be that when she succeeds in obtaining the preference of 0·44 cents., the increase in the prices will benefit, to the same extent, the whole home production of the United States and also that of Cuba's chief competitors, Porto Rico and the Philippines. He considers that it is quite possible that a Cuban reduction by 500,000 tons may be balanced by increases in Java and in other countries ; but the deciding question remains how an additional 500,000 tons of Cubans would affect the market. It is true, a reduction of the Cuban crop may conceivably increase the acreage in some other countries, but this influence can be overrated. " For instance, quite apart from the effects of the Cuban policy, Java would benefit with her new canes, and also in the interests of agriculture in general other countries would protect their beet sugar industry under any circumstances. At all events a restriction to 4,000,000 tons to-day would not cause so much uncertainty as last year, since the way in which President MACHADO managed the last reduction increased the confidence in him. A fixed figure would thus leave much less uncertainty than a possible crop of 4,500,000 tons, or under very favourable circumstances, one of even more."

[1] J. HUMBERT, of Magdeburg.

Notes and Comments.

The Plight of the Greenock Refining Industry.

A good deal of attention lately has been given in the press to the plight of the Greenock sugar refining industry. The vicissitudes of this industry during the past fifty years are a matter of record. They were badly hit by the Continental bounties, but the Brussels Conference saved them from extinction for the time being. More recently they have been subjected to what is admittedly very severe competition not only from the home subsidized beet sugar industry but from imported refined sugar coming from such sources as Czecho-Slovakia and the United States, both of which countries have indulged in the dumping of surplus sugar. The result is that out of five refineries working at Greenock a few years ago the number has dwindled within the last few days to a solitary survivor, the Berryards refinery of the Westburn Sugar Refineries, Ltd. Messrs. Walker & Co.'s establishment is the latest to succumb to the prevailing depression, it having closed down indefinitely this month. None of these refineries, however, has ever been of large output as world refineries go ; and just as in the cane sugar industry the small factories in the West Indies have been the first to feel the pinch in bad times, so it stands to reason that the comparatively small Greenock refineries have lacked the competitive resisting power of a bigger establishment. It must be allowed, however, that last winter a firm of even so big a capacity as Messrs. Tate & Lyle was forced by the then congested state of the market to close down more or less for three months. This, rather than Greenock, is the real measure of the competition that is now facing our refining industry.

The main criticism of the protagonists of the industry is being directed against the subsidy granted to the home beet sugar industry. It is urged that the *fons et origo mali* is the extension of this fiscal assistance to sugars above the raw stage. The refiners say that, as the subsidy was primarily meant to benefit agriculture and the farmer is indifferent as to whether raw or refined is made from his roots, the end would have been achieved by limiting the grant in aid to raw sugar only ; they would go further and claim that in return for this subsidy the Government should have legally limited the output of these factories, during the period of the subsidy, to 88 per cent. sugar. But had the Government done so they would have thwarted the endeavours of those who were financing the factories and seeking by one scientific improvement after another to turn out a better grade of sugar to their own profit. If a new industry is to be started, it is a perfectly reasonable proposition that it should receive facilities to progress in all its branches, and the existence of an older system of finishing sugar for the market is not *per se* an argument for forbidding the newer industry to attain the highest standards that science holds out to it. We must dissent from the argument that there is ample scope for the gaining of general experience and progression in scientific methods along the lines of raw sugar only. That stage of sugar production is now standardized and its operation presents no difficulties. The turning out in one operation of a white sugar fit for direct consumption is a more recent achievement, and it is an open secret that some of our new beet factories have not found the operation plain sailing but have had to experiment at some cost to themselves. It cannot be suggested that they have reached the stage when experiment is no longer needed to perfect the system, so it must be allowed that the subsidy period is a convenient opportunity not only for the farmers to perfect their economic knowledge of beet agriculture, but also for the factories to perfect theirs

of "direct consumption" sugar production. We have already dealt in the past with the argument that beet factories should be content to turn out raw sugar and then have it transported to another factory to be finished as a refined product; we have expressed the view that the modern trend of science in this industry is slowly but certainly setting its face towards the completion of the operation in one stage at one factory. It would therefore be invidious to legislate against such a trend in the interests of any older system that may or may not eventually be found to have had its day.

But the refining interests also complain at the competition of Imperial Preference sugars of the direct consumption variety, such as South Africa and Mauritius send us. So long as these are bona fide products of those countries, we can see no reason, here either, for hampering the production if desired of a higher grade of sugar. But there is every justice in the complaint that it is not fair that Empire units like South Africa, Canada or Australia should be able, in order to take advantage of this preference, to export more than their genuine surplus and make it up by corresponding imports of non-Empire raw sugar. Thus, it is claimed that South Africa has sent us more than she can spare of her own production and has imported sugars from Portuguese territory to balance the shortage. If this is so, then Imperial Preference is being put to a use for which it was not intended and the matter claims the attention of the Government. But this apart, the established basis of Imperial Preference for sugar cannot be re-cast at this stage to lay down limits of permissible and non-permissible sugar; the scale of duties has already been drawn up to allow for differences of quality, and the Government are hardly likely to consent to any radical alteration in the system.

But having said all this, we agree that the Government will have to explore all possibilities of relief on behalf of the harassed refining industry at home. The industry should at any rate be protected in some way from the unfair competition of foreign refined entering this country at "remnant" prices. It is only the incidence of political promises that has prevented the Government rectifying the fault ere now. As it is, the task is one of considerable difficulty, but it should be faced within the next few months. What is wanted (to quote a phrase of the *Glasgow Herald*) is a simple fiscally sound concession which would give the refiners sufficient encouragement to enable them to carry on. We sincerely hope that one will soon be devised.

The Aims of the Imperial College at Trinidad.

In spite of its very recent foundation, the Imperial College of Tropical Agriculture in Trinidad is rapidly settling down and getting into its stride. It has already made its mark on various branches of research, and has called into being an efficiently managed Journal, in some sort replacing the former *Bulletin* and *Agricultural News*. Our attention is now specially drawn to the sugar work going on in the College by the issue of a Sugar Supplement to *Tropical Agriculture*, the official organ of the Institution. Although this Supplement contains articles on all branches of field and factory cane work, we take it that its main object is to draw attention to the fact that the model sugar factory, so generously equipped by British firms, is now completed and in full working order. In an opening article, the Principal details the various courses of instruction being given, and refers in due course to the "beautifully equipped College Sugar Factory," as affording ample means for practical work, "and in fact during the present year the greater part of the routine analyses were undertaken by the technological students during the crop season, and they were also taught how to keep analysis registers, and the elaboration

of factory reports." We have here, then, the nucleus of a training centre for the sugar technologists of the Empire, and coupled with it a centre specially equipped for research on the factory side of sugar production—the importance of which is so obvious that it need not be emphasized.

But the Supplement also has articles on the plantation side,[1] and it would appear that the editors have a larger object in view. Various members of the staff have been invited to discuss the kind of research being done or which they think should be done in improving field production of sugar *in the Empire.* This of course is a very different matter. The College staff has many other duties to attend to besides research, and many other crops to study besides the sugar cane, so it is perhaps not surprising that most of them have contented themselves with articles of a general nature in their respective subjects. These articles indeed serve the useful purpose of indicating how well staffed the College is for training students in tropical agriculture; but it seems to us that the botanical side is not by any means generously supplied, considering the importance of obtaining a thorough knowledge of the crops themselves, their generic constitution, classification, morphology, physiology, and diseases. The present staff is obviously not strong enough to undertake adequate research in the field work connected with the sugar cane. Yet one writer goes so far as to remark that "with a substantial land area attached, the Imperial College would be adequately equipped to give a lead to Empire producers" in the matter of the crop practices of cane growing. And he also "hopes that a complete sugar research station will before very long be created."

Now there are many aspects of field work in the cane crop on which additional light is desirable; but, considering the extreme differences in environmental conditions in the different Colonies, we must hold that it is a matter for discussion whether any central station can be of much use; and if so, whether Trinidad presents the most suitable place for its location. The great advantage that it has is undoubtedly the presence of an expert staff of men interested in field studies, and there are certain fundamental matters which could undoubtedly be worked out with advantage locally; but for a research station it is obvious that a set of whole-time experts will be needed. Valuable data for such a departure will be available from the work connected with the founding of the Cotton Research Institute, for in this crop most of the research is much more closely connected with the field than with the manufacturing side. For the rest, we must look for some influential body, specially interested in sugar production, to move in the matter, as the Empire Cotton Growing Corporation has done for cotton. And it would be interesting to learn the views of the Federation of Sugar Producers on the matter, as they will doubtless be in close touch with the staff of the Imperial College.

The British West Indies Crops.

Barclay's Bank *Review* in its last quarterly report from the British West Indies states that in BARBADOS the canes for the 1927-28 sugar crop are in excellent condition and barring accidents a large crop is to be expected next year. In TRINIDAD prospects for the same crop are on the whole favourable. The 1926-27 crop is estimated to be about 51,000 tons of sugar, which compares with 73,700 tons last season, the drop in production being due to abnormal weather and to insect pests. JAMAICA's sugar crop just closed is put at upwards of 65,000 tons. In the LEEWARD ISLANDS excellent weather conditions have prevailed and a record sugar crop of about 21,000 to 22,000 tons is ex-

[1] These are fully summarized on another page of this issue.

pected in Antigua, while 18,068 tons of sugar have been made at St. Kitts. The plant canes for the next crop have benefited greatly from the rainfall. BRITISH GUIANA has experienced favourable weather, and prospects for the end-of-the-year sugar crop are good. Sugar exports in 1927 are expected to be above the average for the past few years.

The Mauritius College of Agriculture.

The annual report for 1926 of the Mauritius College of Agriculture shows that this training centre for Mauritius is serving a useful puspose and meeting with increased appreciation which will probably be enhanced in the future by the decision of the sugar industry in that island to improve the scientific control of their sugar properties. In all 25 students attended the College classes during the 1926 session ; of these five third-year men completed their course of training and passed the final examination for the College Diploma. The Laureateship of the College was awarded to Mr. DENIS BAPTISTE on the result of this examination, for the purpose of pursuing a course of study in relation to Plant Pests and Diseases at the Imperial College of Science and Technology, London.

The Principal of the College is Dr. H. A. TEMPANY ; Mr. L. BAISSAC is Sugar Technologist : while Mr. R. LINCOLN, B.A. Cantab., who has recently completed his studies at Cambridge and taken his degree in agriculture there, has returned to the Colony to take up the post of Assistant Chemist and Assistant Lecturer at the college.

The Queensland Strike.

The strike in Queensland to which we referred in our last issue, though providing a first class crisis for the Government concerned, proved of even shorter duration than the General Strike experienced in this country in May 1926. Thanks to the firmness of the Labour Prime Minister of Queensland, and the fact that, as seemed probable, the public at large who were the final arbitrators in the struggle were all against the strikers, the latter gave in within a few days after the Government's ultimatum to the Railway men and the strike collapsed. The sugar workers at South Johnstone held out a bit longer, but even they were forced by the trend of opinion to abandon their attitude. This, be it observed, had been in defiance of the decision of the Union executive who had accepted the terms offered by the mill owners.[1] The final decision to resume work on the part of these mill workers was made by 368 votes in favour and 11 against, which figures seem to confirm the assertion that these strikes in Australia are engineered by a small minority of agitators of communist tendencies, and are not generally favoured by the bulk of the workers. One result of this experience will be an early attempt in the Commonwealth Parliament now meeting at Canberra, the new capital, to make it illegal for strikes to be extended beyond the unions immediately concerned in a given dispute. As at home, authority is finding it necessary to circumscribe by legislation the limits to which a whole country's activities can be held to ransom by an unwarrantable combination of workers' unions. The recent crisis in Queensland will not have been useless if it results in some definite modification of the present Australian "right to strike." And it is an ironical reflection that in this case the Governments concerned are of the "Labour" creed and not "Capitalistic" nominees.

[1] Racial trouble was undoubtedly at the bottom of this strike : the mill management claimed to engage what workers they saw fit, and as a consequence Greeks and Italians tended to oust Australian workers, whereupon the latter went on strike and intimidation. In the end the management met most of the objections of the strikers and satisfied the men's unions.

The Australian 1926 Sugar Crop and its Cost.

According to the annual Report of the Australian Sugar Producers Association, the sugar crop of that year was acquired under the provisions of the Sugar Acquisition Act as before. If was estimated that 70 per cent. of the total production would be required for home consumption, and that the remaining 30 per cent. would be exported. Subject to adjustment, £27 per ton of 94 net titre sugar (less £1 per ton to cover administrative expenses and the cost of providing special concessions to certain consumers of sugar) was paid to the producer for the consumption sugar and £9 10s. per ton for the exported sugar or an average of £21 1s. But as the overseas market materially improved during the year the Sugar Board were enabled to make a further interim payment of £1 per ton for the export sugar, and the total payment is stated to be £24 7s. 6d. per ton. This wide difference in price between home and export sugar is not due to a revenue tax on the sugar going into consumption, such as buoys up the price of sugar in the United Kingdom; it is the price Australia elects to pay to maintain its white labour policy and allow the Queensland sugar workers to be the most highly paid of any in the world of sugar production. The unskilled labourer on the Queensland plantation gets on the average something like 17s. per day ; at the other end of the scale is Java where the daily pay is about 10d. We are not concerned here to argue which figure more nearly approaches the hire of which the labourer is supposed to be worthy. But it is obvious that while ruling rates of pay for white and for coloured labour differ so widely, it is futile for white labour to attempt to compete on the world's market with the product of coloured labour, and Australia can only place her surplus sugar on the world market by means of a bounty on export obtained at the expense of the Australian consumer. As a means of disposing of odd surpluses and preventing a glut of sugar in Australia, the expedient is not without its uses ; but if the export quota is going to continue of the order indicated by recent years (in 1925 159,096 tons were exported : in 1926, 80,004 tons)[1] it will probably clash with the views of the other States not interested in sugar, who may demur to financing the Queensland sugar interests beyond what is needed for the home consumption and the requirements of the growing canning trade.

Note on "Saccharum Sinense."

In our June issue (page 314) we published a short note from the pen of Mr. NOEL DEERR, indicating the extreme probability that ROXBURGH'S *Saccharum sinense* is the same as the cane of the Pansahi group grown to some extent in Northern India under the name of *Chinia*. For this surmise Mr. DEERR has now found confirmation from an unexpected source.

In 1848 a select Parliamentary Committee sat to take evidence on the condition of sugar and coffee in the East and West Indies. Amongst those who gave evidence was a Mr. ARTHUR CROOKE, evidently one of the most considerable of the planters who was engaged in sugar planting in Behar about that time. He experimented with cane varieties and in his evidence occurs the statement : "It [Chinia] is the same cane which was no doubt brought originally from China, whence its name Chinea. Besides afterwards on introducing every variety of cane we could get from Calcutta, we found the Chinea cane to be nearly like the China cane ; the China cane was from the Company's garden."

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[1] See Page 549 for details of the exports for the past 26 years.

Maxwell Crusher-Shredders in South Africa.

We learn that the Maxwell Crusher-Shredder installed at the Umfolozi Factory in Zululand, South Africa, has now been operating for about three months with remarkable success. Indeed, the results achieved in certain respects have attracted considerable interest in sugar milling circles there. Such for instance is the extraordinary low power required to drive the shredder-roller. It appears that at a crushing rate of 45 tons of cane per hour the shredder uses only from 10 to 12 h.p. This is equivalent to *less than one-third of a h.p. per ton of cane per hour*; but even assuming say 0·5 h.p. per ton of cane per hour and taking a factory crushing at 50 tons of cane per hour, the shredder would consume only 25 h.p. This must be deemed an extraordinarily remarkable performance, in fact it is an achievement that, we believe, has not hitherto been attained by any known shredding devices, taking into account the quality of the cane preparation. The present case is of particular interest since the cane dealt with by the machine is exclusively Uba—a variety generally known to be excessively fibrous and having a hard and tough rind. The average content of fibre in this case is 17 per cent.

Another important feature of the Maxwell Shredder appears to be the comparatively low shredding speed at which it operates, namely about 350/400 revs. per min. The teeth of the shredder again are of special analysis steel, manufactured for the particular duty, and have withstood successfully the most severe tests.

The results achieved at Umfolozi Factory will doubtless provide the South African sugar engineers with much food for thought, and will lead them to compare this new method with the existing modern method of cane preparation, both with regard to efficiency and economy.

Dr. MAXWELL, the inventor of the machine, has just returned to London from South Africa, where he superintended the initial operation of the above-mentioned plant. We learn that he will leave shortly for Egypt to be present at the operation of another, but larger, Crusher-Shredder, which the Sugar Machinery Manufacturing Co. are supplying to the Nag-Hamadi Factory belonging to the Société Générale des Sucreries et de la Raffinerie d'Egypte.

With reference to the figures we gave in our August issue (page 436) showing the "Per Capita Consumption of the Various Countries of the World," it is as well to point out that the average of each Continent was not the arithmetical average of the various districts enumerated, but was calculated by dividing the sugar consumption by the total population. This accounts for a supposed disparity in the figures.

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The death was recently announced of Dr. F. M. MRAZSEK, a native of Vienna, who was formerly chemist to Messrs. Czarnikow & Co., sugar brokers, London. The deceased was an able chemist, a clever worker in the laboratory, and well read in his subject, though his actual interests were artistic rather than scientific. Of a retiring disposition, he was much esteemed as a loyal friend in the circles in which he was known.

Among new companies recently registered in the United Kingdom are the following:—British Carbo-Union, Ltd. (224,165). Private. Manufacturers of activated carbon and chemicals of all kinds. Nominal capital, £12,500 in 10,000 preference shares of £1 and 100,000 ordinary shares of 6d. C. G. Cave, 21, Cholmondeley Avenue, Harlesden, N.W.10 (subscriber). Penick and Ford, Ltd., 15, Eastcheap, E.C.3. (224,067). Private. Manufacturers, producers and dealers in all kinds of sugars, molasses and kindred products, etc. Nominal capital, £5000 in £10 shares.

British Beet Sugar Notes.

Considerable activity is being shown all over the country in projecting new beet sugar factories in likely centres. It is realized that where factories are not firmly established within the next few years, their chances of overcoming their initial difficulties without heavy financial loss are lessened considerably owing to the fact that in another three years the subsidy will be further reduced. It is foreseen that the future of the industry will in the end depend a good deal on its extent when the subsidy is due to disappear *in toto*. As the President of the National Farmers' Union (Mr. T. BAXTER) has urged, when the time comes to review the whole matter, if 50 or so factories are in existence, no Government would dare to ignore the importance of the industry. Farmers are therefore advised to do all they can to extend the industry. The new prices for roots have caused a good deal of grumbling amongst individual growers, but the Farmers' Union consider they were the best that could be secured and are capable of yielding profit to any good farmer ; any attempt to organize resistance would not only be a breach of faith but would deal a blow to the principle and practice of collective bargaining.

As to the ability of a good farmer to make profit at the price of 46s., Sir ERNEST JARDINE who has had 20 years' experience of beet growing in this country has sent to the press figures showing what has been achieved by a farm which grew last year 272 acres on poor, highly rented land. The following table shows what was actually achieved in 1926-27 and what will, other things equal, be possible under the reduced price.

	1926-27		1928-29.
Average yield per acre..	10 tons, 15 cwt	..	10 tons, 15 cwt.
Average sugar content..	18·1 per cent.	..	18·1 per cent.
Actual price received per ton of beet	£3 0s. 6d.	..	£2 14s. 4d. (based on 46s. for three year contracts).
Cost per acre, including rent, management and carting to factory.. ..	£17 11s. 5d.	..	£17 11s. 5d.
Gross return per acre	£32 10s. 4d.	..	£29 4s. 1d.
Profit per acre	£14 18s. 11d.	..	£11 12s. 8d.

It is pointed out that to-day's average price on the Continent is less than 30s. per ton. Germans pay their best agricultural labourers 4d. per hour, and much of the actual work of beet cultivation is done by women and girls at 3d. per hour, whereas the rate in this country is 8d.

Amongst new projects for sugar factories is one at BECCLES, Suffolk, which is about ten miles from Cantley. Providing that a promise of at least 8000 acres of roots can be guaranteed by the end of October, a company is prepared to erect a factory on a site to be purchased from the Corporation of that town. The factory would cost nearly half a million. A similar size of factory is being considered at BRIGG, Lincolnshire, where a company called Sugar Industries Auxiliaries Ltd., of London, have secured the option on a site near the river Axholme. The same syndicate, it is reported, are also considering possibilities at HULL. On the other hand, Hull has also come into consideration by the Anglo-Scottish Beet Sugar Corporation as a possible site for a further factory for this group. Another district which is receiving the attention of interested parties is Staffordshire where an option is stated to have been secured on a site near PENKRIDGE and it is planned to erect for 1928 a factory capable of dealing with 10,000 acres of beets. A company with Viscount LEWISHAM at its head is the promoting party.

The work of erecting the beet factory at BLUNHAM, Bedfordshire, is to be begun shortly, and the factory should be ready for the 1928 campaign.

It is to cost half a million, and is stated to be of double the capacity of the Peterborough factory. This will, incidentally, be the fifteenth factory in the country.

The projected factory at Bridgwater, Somerset, has been turned down after all by the National Farmers' Union, because while the latter had secured the necessary minimum acreage of 10,000, the Anglo-Dutch Group who were proposing to erect the factory would guarantee no higher price for the beets than 41s. per ton of 15½ per cent., which price is lower than the national price of 46s. In these circumstances the local branch of the National Farmers' Union unanimously decided to reject the offer.

The Hereford factory projected by British Sugar Developments, Ltd., has been abandoned in view of the opposition offered to the dumping of factory effluent into the river Wye. The Company were unable at this stage of knowledge of how to deal satisfactorily with effluents to guarantee freedom from pollution. The district will, however, possibly see one or more factories erected in other quarters; thus Messrs. Duncan Stewart & Co., Ltd., are reported to have a site in view near Ross. There is in any event a strong desire in Herefordshire by both farmers and labour interests for a sugar factory to be introduced.

The question of satisfactorily dealing with sugar factory effluents continues to be the subject of expert investigation. The Rothamsted authorities believe that they can see a way of coping with the problem and hope to produce a satisfactory filter at an early date. At Felstead the Anglo-Scottish Corporation have constructed a lime-separation pond which they confidently anticipate will remove any cause for complaints with regard to their effluent, such as were made last year by local fishing and game interests. The problem of dealing with the effluent so as to avoid pollution of rivers is no new one. for Mr. W. T. Chadwin has reminded readers of the *Times* that Mr. James Duncan who erected the Lavenham beet sugar factory in 1870 had to discontinue operations because his effluent "became a nuisance to certain gentlemen who amused themselves fishing for the few jack to be found in the stream,"[1] and notice to abate the nuisance was served on him.

The Orchard Sugar Co., Ltd, of Greenock, in their annual report state that last year's working resulted in a loss of £46,932, which is explained as being mainly due to unsatisfactory conditions at the factory and loss on farming operations. Certain alterations have been made which the Directors are advised should admit of the factory being operated on a profitable basis during the coming season.

The Board of Agriculture, reporting on the condition of agricultural crops in the United Kingdom at the end of September, stated that the Beet crop generally is good, but roots are large and inclined to be coarse. In view of the fact that the British summer of 1927 has been described by experts as the most disastrous season for agriculture since the year 1879, owing to persistent rain and lack of sunshine, it will be instructive to see how far sugar beet has surmounted these drawbacks, and proved one of the few exceptions to a widespread tale of ruined crops.

"After producing more than 37,000 tons of 'Snow-White' granulated sugar, with a recovery in excess of 93 pounds of refined sugar per 100 pounds of 96° test sugar, by the 'Suchar process,' it is the writer's opinion that this process is sure to have a far-reaching effect in the production of refined sugar on the plantation in the near future."[2]

[1] *Chamber of Agriculture Journal*, 1874.
[2] E. K. Jughans in *Facts about Sugar*, 1927, 22, No. 37, 898.

The Sugar Supplement of "Tropical Agriculture.

The sixteen papers in this Supplement are, with one exception, the work of members of the staff of the Imperial College of Tropical Agriculture in Trinidad. The health and efficiency of the labourer, costings and records in factory and plantation, cane breeding and the potentialities of genetic work in connexion with it, the physiology of the cane plant and its pests and diseases, agronomy and the local manufacture of organic manures, deal mainly with the plantation side. Chemical research problems in sugar manufacture, the components of sugar cane juice, by-products of the factory, and the application of physico-chemical determinations to the control of sugar manufacture are discussed as regards sugar making; while over a quarter of the pages is devoted to a description of the new College factory and the courses of instruction connected with it.

There appear to be several reasons why the sugar industry should be thus selected at the present time for special study. In the first place, it is closely connected with the history of British Colonies in the tropics. It was this fact that inspired Napoleon with the idea of introducing into France the manufacture of sugar from the beet and liberally financing it; and the accuracy of his forecast can be readily appreciated by a study of the economic history of our West Indian possessions during the past fifty years. In the second place, wherever the sugar cane is grown on a commercial scale it tends to become a dominant crop; and this has been the case with a number of British Colonies, which are accordingly suffering severely during the present phase of unbalanced over-production. Trinidad has a large stake in the Imperial College, and although fortunately not so dependent on the cane industry as some other islands, possesses a considerable number of sugar estates of all classes, which provide a fitting background for studies of the industry in all directions.

But there is a third inducement to the compilation of this Sugar Supplement, and that is to draw attention to the completion of the Instructional Sugar Factory attached to the College. The very coming together of the scientific experts necessary for its successful functioning should mark the Imperial College as a centre of sugar work in all its branches for the Empire at large. It is not surprising moreover that, although apparently fewer in number, the more important articles are connected with the factory side, the heart of the plantation. There is no question that the College is stronger here; and it must also be remembered that the stage of scientific evolution in the factory is far and away ahead of that in the field. The reasons for this are of course obvious; but it must be remembered also that the type of investigation is very different in these two sections. The sugar factory, in spite of great variations, is in principle the same all over the tropics and has one very definite objective; while the plantation problems vary from country to country and even in the same country: what might be sound scientific advice in one set of conditions would be altogether wrong in another—witness the vexed questions of humus in the soil, liming, and burning the canes. It is the purpose of the present article to give some account of the papers dealing with plantation matters, as well as to extract from others such points as directly or indirectly concern the field side of research.

There are no papers, unfortunately, dealing with the cane plant and its growth or with the soil and its treatment. Of these, the soil has in all probability received a very careful study; but it would be ungracious to expect more from the authority on this subject (Professor HARDY) than he has already contributed to the Supplement. We are driven to the conclusion that the other line of study mentioned has not as yet occupied the attention of the

few members of the staff capable of dealing with it. But F. HARDY, in his summary of chemical research problems connected with sugar production, briefly comments on some of those connected with the physiological study of the plant—without however referring to the extensive Java literature on the subject. He points out that little is known of the fundamental processes which go on in the cane plant, and that physiological and bio-chemical research is needed in various directions. For instance, as to the factors controlling the synthesis, transformation and translocation of sugar and other substances in the tissues, the physiological and bio-chemical differences in health and disease of different varieties, the processes of ripening and the effect of tillering and arrowing upon it, the rôle of various substances in respect of growth processes, and the connexion between soil conditions and sugar cane growth and metabolism.

The relations of various substances in the soil and plant are then considered. The possible relations between *phosphate* in the soil and in the juice require further study, because of the importance of this salt in the behaviour of the juice in the factory. A positive correlation has been obtained by one observer between phosphate added to the soil and the amount in the juice; whereas another, failing to confirm this relation, has observed that different varieties of cane are characterized by different amounts of phosphate in their juice. The author remarks that, in experiments of this type, it should be first ascertained whether manuring with phosphate really increases the rate at which it can be absorbed by the plant.

Sugar cane is notably a *potash* plant, in that 90 per cent. of its ash consists of potassium and sodium salts, while only 10 per cent. is connected with calcium and magnesium. The potash relation in the cane plant appears to be intimately connected with carbohydrate metabolism, and also with resistance to certain diseases; although as regards the latter the magnesia-lime ratio has been stressed by one observer. The *calcium* relation, apart from its effect on the soil, appears to remain somewhat obscure. Experiments have shown that the addition of lime does not generally increase cane production, while excess leads to leaf chlorosis. The possible relation between lime in the soil and the formation of fats and wax, and their distribution over the plant's surface, has not yet been tested; although its significance in regard to drought resistance will be obvious.

The *nitrogen* relation between the plant and the soil is fairly well understood. "The fact that the sugar cane can utilize nitrate-nitrogen but not ammonia-nitrogen seems to have been definitely proved by McGEORGE in Hawaii. This implies that, unless conditions are suitable for the rapid conversion of ammonium salts into nitrate through the agency of specific soil bacteria (nitrification), the use of these salts for manuring sugar cane is not likely to be remunerative. Nitrification in soils takes place best at neutral or alkaline reactions." The *acidity relation* requires more detailed study, and is extremely complex: the present view regards it as chiefly a factor in (1) root hair absorption, (2) production of available mineral food, and (3) the activity of micro-organisms which control nitrogen transformation. It has been found that excessive acidity may induce harmful amounts of aluminium, iron and manganese, which may result in tissue disintegration and root rots.

The *water relations* of the cane plant are regarded as fundamental; and detailed studies are required in various kinds of soil, as affected by drainage, exposure, tilth, organic matter, etc. For every pound of dry matter produced in the cane (2·8 lb. of fresh green material), some 500 lb. of water are transpired. "Hence, a well distributed rainfall of at least 60 inches a year,

if all of it is utilized by the plant, will be required to yield large crops unless irrigation is practised." The *humus relation* between soil and plant, apart from the water question, is somewhat puzzling. Sheep manure is affected by the planters in Barbados, although the amount given appears to be too small greatly to increase either the water or the food in the soil. Possibly the ascribed benefits may be due to micro-organic inoculation, and the subject deserves the attention of the microbiologist.

HARDY then considers the question of *sampling the canes* as to ripeness for factory purposes, and states that there is room for improvement, in the introduction of an easy and rapid yet accurate method. The use of the refractometer is approved, either by employing a hypodermic syringe or by cutting out cores of tissue by a cork-borer. He quotes an opinion from Madras, where a good deal of study has been devoted to the subject, that "when the ratio of the Brix degrees of the juice from the top and the bottom halves of a cane is unity, the cane may be regarded as ripe." *Deterioration of canes* before and after reaping is then briefly considered. Further work is needed to assess the damage done by pests and diseases, and to refer it to the special plant tissues, cell components or physiological processes affected. Damage by cane fires appears to depend on the local temperature, and may accordingly be considerable or not very pronounced. The loss in cut cane left in the field or factory yard is illustrated by recent figures from Trinidad : the loss in available sucrose was approximately 5 per cent. in one day, 10 per cent. in three days, and 15-27 per cent. in six days. Additional data are called for from other countries and for different canes grown under various conditions and for cut canes exposed to different degrees of atmospheric humidity.

The article on *Cane Breeding* was prepared at short notice by the present writer and will not be referred to here. In the Supplement it is preceded by a very brief statement by E. E. CHEESMAN on the *scope of genetic research* on the sugar cane. He considers that botanical research may be helped by the genetic analysis of existing cane varieties, especially with a view to improving the methods adopted in the practical breeding of sugar cane ; although where the clear duty "is to provide local industries with better canes by the shortest possible way, the present technique, modified as knowledge advances, is likely to remain useful for many years to come." The factors of the extremely complex character of yield are roughly arranged in a linked table and include quantity of cane, proportion of juice, and sucrose content in the latter, at least six factors being separated. "Actually there are more because such a character as percentage of sucrose in the juice is almost certainly dependent on several factors though it is not known what these are." "At present we do not know how a single one of these six characters is inherited, although we do know that every cane tested has proved to be a highly complex hybrid, whose characters segregate, and recombine in its seedling progeny to form a series of plants among which almost every conceivable variation occurs." The art of cane breeding lies in the recognition and preservation of the good combinations when they occur, although experience shows that these are much rarer than the bad combinations. But the breeder can do little to influence the occurrence of good combinations, although he knows by experience which parents are most likely to produce valuable offspring. "The time has come when an attempt must be made to breed new canes by systematic analysis of existing varieties into their good and bad components, followed by synthesis of new canes from the good ones with elimination of the bad."

The method by which this can be done is then described, namely by a series of successive selfings till the seedlings no longer continue to split up

into series of types. "When this stage is reached the variety will have been analysed into component parts, represented by a number of different cane plants each of pure constitution. By a judicious recombination the bad qualities present in the original parent can be eliminated and the good ones brought together into one or several really good combinations." The process is considered to be slow and costly but worth while because of "ultimate certainty of obtaining much better canes." Only thus can the constitution of the canes be understood while "during the course of the work the results should be of considerable use to the stations engaged in practical breeding."

Agronomic research is dealt with in one article by J. S. Dash, under the headings, Varieties, Soil Management, and Crop Practice. He remarks that, excepting in the matter of varieties, the research devoted to the field side of the industry in British possessions is very inadequate, but little reference is made to those countries where considerable advances have been made from time to time. The article is of a very general character, and is largely content with the mere enumeration of subjects requiring study ; consequently there is little material to lay hold of for a summary such as would interest the readers of this Journal. Presumably research work on field practices has not as yet reached a sufficient degree of importance in the College for the author to describe it. He lays great stress upon the accumulation of details of work being done elsewhere regarding crop practices in all directions ; but does not produce any analysis extracted from the great mass of literature already present in the College library. This of course is a difficult piece of work, but it would have been interesting if some selected aspects of field work had received a somewhat detailed comparative treatment.

The paper by Hardy on *Organic Manures from Sugar Cane* is one of great interest, but cannot be fully dealt with here because of its compact nature. The author has devoted a great deal of time to this important subject, and his summary of the later advances is printed in full elsewhere in this issue.

Insect pests of the sugar cane are treated in a short article by H. A. Ballou, which as might be expected is full of interest. Trinidad is fortunate as compared with many countries in that, although they occur, insects which cause serious damage elsewhere are of little economic importance in this island : but the converse is also true, in that the one important insect pest in Trinidad canefields is more or less harmless elsewhere (is there any connexion between these two facts ?).

It is satisfactory to learn that the comprehensive campaign against the froghopper is "well started, observations have been made and careful records have begun to accumulate. Studies in soil science, in the use of insecticides, and in the value of the parasitic fungus are well under way. The blight which usually follows froghopper attack, often causing extensive areas to look as if burnt by fire, appears to be a physiological or bio-chemical result. The effects of drainage and drought, of tillage and of manures become subjects of enquiry and research." The continuous growth of sugar cane on the land in the tropics, with overlapping crops, suggests that biological control by insect enemies is likely to be a profitable line of work. In Trinidad the moth borer appears to be controlled by a parasite but, although the same parasite occurs in great numbers in British Guiana, it is almost entirely ineffective there ; and it is considered that the burning of the trash in the latter country may be responsible for this difference.

The problem of froghopper in Trinidad is recognised as being extremely complex. And although the pest is of only local interest it is probable that its investigation will lead to improvements in field practices, which may be of

importance in other countries as well and, indeed, possibly in other crops as well as in sugar cane. "The control of insect pests of the sugar cane is a subject in which the College can help and is helping. The problems nearest at hand will naturally be the first to be studied, and as staff and funds accumulate other problems can be taken up. The West Indian group of sugar localities has its general pests, while the localities have special problems. The field for investigation is interesting and the means for research study are being developed."

A short note is appended on *Mycological and Bacteriological problems* by H. R. Briton-Jones; although, apart from an investigation into the economic possibilities of the green Mascardine fungus (*Metarrhizium anisopliae*) as a factor for controlling froghopper, no special research work has been undertaken by the mycological staff. This is owing to the fact that it consists of only one member at present employed, and his services are required in other directions. It is recognised that there is ample scope for research with regard to the sugar cane and, as instances, root disease and mosaic are given for the field, and the micro-organisms in the manufacture of rum and manufactured sugar for the factory, together with the whole question of the use of by-products, especially as regards organic manures. It is suggested that a study of the nutritional requirements and physiological processes of micro-organisms in the tropics may quite possibly result, for instance, in the production of a different although somewhat similar product which would yield far better and cheaper results than "Adco."

The use of *By-products* in field and factory is summarized by W. Scott. He remarks that the casual visitor to a modern factory is greatly impressed by the devices for steam economy, the use of bagasse as fuel, filter-press cake as fertilizer and molasses for various purposes; and feels that nothing is wasted. The technologist is not so sure about this: the mere using of a by-product does not preclude waste, and what is wanted is to use it to the best advantage. The use of *trash* and *cane tops* is still a matter under debate; in some countries they are simply burnt, in others carefully utilized as litter for the pens or dug into the ground. In Hawaii trash appears to give no advantage to the soil on irrigated fields, whereas it has been found of distinct value in the absence of irrigation. Such variations are dictated by general economic conditions, the climate and the soil; but where conditions are favourable the most scientific method is to return it to the soil in the form of pen manure.

Bagasse or *megass* has been used for fuel since it was first discovered to be possible to do so; and in modern factories it has been so economized as to leave a large surplus. And the question had to be faced as to what to do with it. In Hawaii a coarse paper was made to act as a mulch in pineapple plantations: it has been used as fuel for locomotives in other places although this use is condemned in Java because of its slow combustion: where nothing suggested itself it has been simply added to the cattle pens or returned to the fields. Latterly it has been determined as an important source for cellulose, and the question has even arisen whether it would not be profitable to displace it from its fuel position altogether and use something else.

It makes excellent *fibre board* which it is claimed has remarkable heat and sound insulation. The best known form is the "celotex" of Louisiana; and there are other projects for using it as packing-case material and lumber generally. Dry bagasse contains 50 per cent. cellulose, and a recent process claims to have overcome the difficulties, so that *paper pulp* of good quality can be made from it. If the manufacture of high grade paper were

rendered possible there would be a great commercial future, because of the ever increasing cost of the transport of ordinary wood pulp. Lastly, *cellulose*, already mentioned, would seem to be a practicable outlet, both for explosives and artificial silk. The whole matter is of course dominated by economic considerations and before making any alterations these must be fully explored. Making the necessary alterations in the boiler plant would be a costly business, and the transport of such a light, bulky material would be difficult. The aim should be to do most of the preparation at the factory itself and, if paper pulp were possible, all difficulties would be greatly diminished. The author notes that, if it were a question of introducing a new fuel, the old idea of diffusion might very well have a fresh trial : this would have certain advantages in rendering the factories more flexible in their capacity at different times, and would of course do away with the difficult problem of removing the colloids from the juice.

Molasses presents many problems, as it always has done since the time when every factory found a ready sale for its rum. With prohibition and high taxation the world production of rum has declined greatly, and other uses have to be found. Molasses is sometimes used as *fuel*, to supplement the bagasse for steam. A pound of molasses with 60 per cent. total sugars is equal in this respect to one pound of bagasse with 20 per cent. moisture, and the market value as fuel would not be more than 1¼ cents per gallon. From this it will be seen that it can only serve as a fuel where this is very costly and there is no other use for molasses. Lastly, there are *alcohol*, *yeast*, and its by-products. In fact this has been claimed as the most profitable use for it, and probably may be so in certain large countries such as Germany and the United States. In these countries there is a large and increasing demand for industrial alcohol to be used in many industries ; and a huge artificial demand has been created in the latter country for yeast and carbon dioxide, the latter for beverages, food preservation and refrigeration. It is stated that a large proportion of the molasses used in the United States is imported from the tropics, and that the producer seldom averages a price of three cents per gallon.

The author gives his experience when called upon in a British Colony to investigate the technical and economic aspects of utilizing the molasses for the production of alcohol, yeast, carbon dioxide and potash, and this is very interesting reading. The conclusion seems to be that, without concerted action among the sugar maufacturers, in the development of markets and the removal of legislative barriers, little can be hoped for in these directions. The production of *motor spirit* is still in its infancy, and is of special importance from the Empire point of view because of the very small proportion of petrol produced within it to meet its requirements. The uses of these two fuels are compared in different types of engines, and the problems still to be solved in the motor spirit industry before it can be firmly established are enumerated.

The use of molasses in *cattle food* has long been known and practised, the first form produced on a large scale being "molascuit" in Demerara. But the manufacture of such foods has gradually shifted to the consuming countries and efforts should be made to bring it back again. It is suggested that as molasses feeds must be supplemented with rich protein material, these might provide a suitable outlet for the utilization of rotation crops oh sugar estates ; while the balance could be exported direct, once the deterioration in transit and storage were overcome. As a *fertilizer* molasses has found favour in Mauritius and Java. According to certain figures of increased production

the net value realized was 2½ cents per gallon, on a conservative basis. The results obtained in Mauritius are greater than might be expected from the chemical composition of the molasses, and it is suggested that the explanation may lie in the aid given by it to nitrogen fixing organisms in the soil. Hitherto manurial experiments in other countries have not given such favourable results as those obtained in the two countries mentioned.

The use of *filter-press cake* has also produced better results in some countries than in others, and two methods adopted at St. Madeleine in Trinidad are interesting and worth repeating. On certain estates six inches of the cake are evenly distributed over the pen in crop time, say, once or twice a week, and covered with litter : after continued trampling a pen manure of excellent quality is produced. Another portion of the cake is transported to a siding, and throughout the cropping season alternate layers of cake and *ashes* are built up : it is proposed to add to this heap later all refuse containing organic matter, and to spray it at intervals with *lees* from the distillery. The ashes from the furnaces are rich in potash and phosphates and this appears to be a logical method of disposing of them. When not used as a fertilizer they are used on railway tracks and paths, and light bricks for paving can also be made from them.

The author concludes this summary with the remark that the apparent apathy of the planters in the matter of utilizing by-products is largely due to a lack of organization, and also to a proper orientation in the industry taken as a whole ; and that, with recent developments, and liberal support of Research Institutions, there is little likelihood of the development of by-products being overlooked.

Little space is left for the two remaining papers on subjects of import to the plantation, namely, *Health and Efficiency*, and *Costings and Records*. In the former E. A. SEAGAR states that his department of hygiene was brought into being by a subvention from the Board of Health of the Rockefeller Foundation. In a brief note, he first refers to the stimulating action of the Board on public interest in the connexion between the health and the efficiency of the workers ; and the fact that many of the ailments in the tropics are preventable, in that they are due to the invasion of the body by animal and vegetable forms which are often carried by insects.

He also refers to nutrition. " The food supply of the world has only increased by 1 per cent. of recent years and there is insufficient food produced to feed the inhabitants " ; and it was long ago predicted that the temperate regions would ultimately have to call upon the tropics for a supplemental supply. But one great difficulty in the torrid zone is the unceasing conflict between animals, plants and man, on the one hand, and the teeming lower forms of life seeking to grow and increase at their expense on the other. The mastery of man can only be finally obtained by scientific research, through which he will be able to strike a balance between these contending forms, and control them. To illustrate the need for such study he gives a local example. There are nearly 100 species of mosquitoes in Trinidad : twelve of these belong to the genus Anopheles : only three of these appear to act as carriers of malaria, and only one of them can be regarded as at all efficient in so doing. This form has been found to have definite breeding proclivities as regards season and type of water. The fight against malaria is thus narrowed down and rendered easier, and the cost of control will be proportionally reduced. Evidence has accumulated that defective diet, apart from actual deficiency, has a great deal to do with infantile mortality, and also directly or indirectly with the diseases and mortality of the adult labouring classes. This is one of the cases where

co-operation between the estate owners and the department of hygiene will lead to useful results.

Trinidad has the statistical reputation for a high death rate from nephritis or inflammation of the kidneys : this ranks third as a cause of deaths in the island. It is often thought that there may be local factors operating to produce it ; and the department is now investigating this aspect, with the cordial assistance of the medical department. Many similar problems remain to be studied, the solution of which will not only lengthen the span of life and efficiency of the labourer, but also be a direct gain to the employer.

The subject of *Costings and Records* is considered by G. WRIGHT from the point of view that their analysis will act as an aid to management. It is this analysis by the manager which is the important thing, and cases are given of definite economies being effected in this way. The paper is closely reasoned, and would perhaps be more easily read if a few more examples had been interspersed. The subject is a very wide one, including as it does pettifogging savings of a few pence in oft repeated tasks and the study of the appropriate size of an estate for economic working, with the sub-division or amalgamation of its sections and heads of expenditure. Space forbids anything more than this brief mention of the paper, which it will be worth while for every manager, from the smallest to the largest to read, mark and inwardly digest, unless he has already devoted careful study to the question. On some of the larger estates in the island elaborate and efficient systems of cost accountancy have of course been instituted, and in all cases "have proved beneficial."

C. A. B.

Formosa.

Sugar Output, 1926-27.

His Majesty's Consul at Tamsui (Mr. P. D. BUTLER) informs the Department of Overseas Trade that final statistics for the Formosan Sugar Crop 1926-27, show a total production of 6,709.944 piculs (about 396,000 tons) of centrifugals and 142,000 piculs (about 8300 tons) of brown sugars. As compared with the figures for the previous season, centrifugals decreased by 1,405,000 piculs (say 83,000 tons) and brown sugars by 78,000 piculs, or 4600 tons. Production of centrifugals by each of the principal sugar companies was as follows :—

Company.	Production. Piculs.	Tons.
Taiwan Sugar Co.	1,801,352	106,370
Shinko Sugar Co.	87,185	5,148
Meiji Sugar Co.	867,045	51,199
Dai Nihon Sugar Co.	613,018	36,199
Toyo Sugar Co.	818,127	48,310
Ensuiki Sugar Co.	873,762	51,596
Niitaka Sugar Co.	530,480	31,325
Teikoku Sugar Co.	883,280	52,158
Tainan Sugar Co.	113,040	6,675
Taito Sugar Co.	46,541	2,748
Shinchiku Sugar Co.	24,371	1,439
Sharoku Sugar Co.	40,175	2,372
Koshun Sugar Co.	11,568	683
	6,709,944	396,222

Organic Manures from Sugar Cane.[1]

The Utilization of Field and Factory Refuse.

By F. HARDY, M.A.
Professor of Chemistry and Soil Science.

The profitable utilization of field and factory refuse is one of the most important problems in modern sugar cane agriculture. Among the available waste products are cane-tops, weeds, grass and roughage, cane-trash, cane-bagasse, filter-press mud, low-grade molasses, scums and skimmings, boiler ash and clinker, flue and stack dust, fermentation-vat sludge, lees, machinery and floor washings, and animal excreta. Usually these waste-products are either left on the land to rot, or relegated to tip-heaps, or diverted down drains to rivers and the sea. Even when some attempt is made to make use of them, the methods practised are wasteful or even harmful, the main object in many cases being merely to dispose of the refuse with the least possible trouble.

In considering the various methods whereby waste products may best be utilized, primary consideration should be given to their possible rôle in the problem of fertility maintenance in sugar cane soils. It is a fitting adage that everything that comes from the soil should be returned thereto.

The Utilization of Waste Vegetation.

Apart from material used as stock-fodder, vegetable matter left on the land is liable to decay in a manner which leads to losses in substances of nutritional value to crops. Futhermore, fresh green material merely turned into the land often ferments in such a way that little true humus is formed from it. On the other hand, dry vegetable matter is difficult to incorporate, and it may temporarily deplete the soil of nitrate-nitrogen. Hence the most satisfactory way of dealing with waste vegetation is to treat it by processes that will preserve its nutrient components, and convert its cellulosic substance into valuable humus. There are various means for doing this.

(*a*) *Pen manure.*—A time-honoured procedure, well known to everyone, is to use the waste material as bedding for stock, and thus to make pen manure from it. The biochemical processes whereby litter impregnated with animal excreta becomes changed into pen manure through the agency of certain micro-organisms, need not be discussed again in this place. Careful study of these processes at the Rothamsted Experimental Station has led to a complete understanding of the fundamental facts underlying the mechanism of their action. Moreover, it has led to a feeling of confidence that satisfactory pen manure can be manufactured without the intervention of farm animals. This departure from the belief that the virtue of pen manure lies entirely in its formation through the operation of mysterious and uncontrollable processes marks really important progress.

(*b*) *Synthetic pen manures.*—We now know that, given a suitable *nidus*, certain ubiquitous micro-organisms can convert waste vegetable matter into material that resembles pen manure in all its valuable properties. The conversion requires certain well-defined environmental conditions, such as a suitable water-content, a suitable degree of aeration, the presence of sufficient base to neutralize acidity, and sufficient food material, notably nitrogen, to satisfy the needs of the organisms.

In a pen manure heap, the requisite nitrogen is supplied by compounds contained in animal excreta. In a synthetic manure heap, the nitrogen is added in some other form. There is no advantage to be gained by greatly increasing the amount of nitrogen in any case, as the believers in heavily

[1] Reproduced from *Tropical Agriculture*, IV, No. 9, 47-48.

cake-fed bullock manure have discovered. Generally, in a pen manure heap, the amount of nitrogen added in excreta is more than enough to satisfy the nitrogen requirement of the micro-organic flora needed to convert the whole of the cellulose of the litter into manure. Recognition of this fact has led to the development of the *Mauritian pen manure system*, whereby a smaller admixture of animal excreta with waste vegetable matter of the sugar estate is allowed than ordinarily obtains in the preparation of normal pen manure.[2]

The nature and composition of the waste vegetable matter employed in the making of manure heaps, quite apart from considerations of the nitrogen question, introduce additional factors of great importance. Cellulose decomposing organisms require (besides nitrogen) organic foodstuffs of the nature of simple carbohydrate substances, such as gummy pentosans, starches and certain sugars. Different vegetable materials contain different amounts of suitable carbo-hydrates, and many of them resist breakdown because of their deficiency in these compounds, and because of their high content of fibrous, woody cellulose. Thus, cane-tops, cane-trash, and succulent weeds and grasses are quite easily broken down, because they contain relatively high percentages of the simpler carbohydrates (between 40 and 55 per cent. of the total dry matter), and low percentages of resistant woody cellulose. On the other hand, cane bagasse, scrubby weeds and woody bushes contain much smaller proportions of the simpler carbohydrates that are needed as food for the micro-organisms, and much greater proportions of resistant woody cellulose. They are therefore less easy to break down, and seldom form satisfactory manure, unless specially treated.

(i) "*Adco*" *manure*. In the "Adco" *process*, decomposition of waste vegetable matter is accomplished by artificially providing the right conditions for the growth of the proper micro-organisms which are always naturally present in sufficient numbers thoroughly to infect the heap.[3] The patent mixture made by "ADCO" Limited, contains sufficient extra nitrogen and neutralizing base to satisfy all requirements.

(ii) *Distillery sludge manure*. Theoretically, certain nitrogen compounds other than those used in the manufacture of "Adco" mixture ought to serve the same purpose, although the resulting manure may not be so well balanced. We have seen that the nitrogenous components of animal excreta (chiefly urea) are adequate and suitable. It appears possible that the nitrogen compounds present in distillery sludge (consisting mainly of dead yeast cells) and factory skimmings, might also prove suitable and adequate. The important preliminary trials performed by Mr. V. M. HINCHY at Caroni Estate, Trinidad, and described in *Tropical Agriculture*, July, 1927, certainly demonstrate that this contention is not unreasonable, provided all the requisite conditions are observed.

(iii) *Filter-press mud manure*. Perhaps filter-press mud may be used instead of distillery sludge in making synthetic manure from waste vegetable matter of sugar estates. It certainly is worthy of trial, either alone or mixed with other nitrogenous materials.

(iv) *Compost manure*. A further extension of these suggestions points to the possible utility of making compost heaps from most of the waste materials enumerated at the outset. The basis would be cane-trash, scrub, grass, and surplus bagasse. The extra nitrogenous components would be distillery sludge, filter-press mud, and even molasses. The water required could be added as lees and factory skimmings. If the compost heap were made in

[2] See *Tropical Agriculture*, Vol. I, 1924, p. 116.
[3] See *Tropical Agriculture*, Vol. II, 1925, p. 108.

the open, rain-water would serve to make up deficiencies, but it would be advisable to guard against excessive leaching, otherwise valuable ingredients such as potassium compounds, might be lost.

In order to render a compost heap more open and permeable, boiler-ash and stack-dust might be sprinkled over the layers of vegetable matter as the heap is being constructed. The procedure is certainly worthy of extended trial, for it would adequately deal with large quantities of waste matter, and would convert all of them into a manurial material whose composition and condition would render it eminently suitable for direct application to the land.

Economic Considerations.

The chief requisite of any system of manure manufacture is that it should be practically feasible and reasonably cheap. In making ordinary organic manure in stock-pens in the estate yard, fodder and litter must be carted from the fields, traces and waysides, and provision made for the sheltering and watering of the farm animals. Furthermore, the finished manure must be carted out again at the correct time to the places where it is to be applied. The transportation costs are thus liable to be very high, especially on estates that are not provided with efficient railway systems or with adequate roads. Consequently, fields remote from the yard are liable to be neglected when the manure is distributed.

To overcome these objections, field pens are frequently advocated. For field pens to be satisfactory, the breed of stock should be one capable of resisting exposure to weather. Furthermore, an adequate water supply in the form of streams or ponds must be easily available, and the stock-keepers must be reliable, for decentralization reduces opportunities for strict supervision.

These conditions are not materially altered when the Mauritian system is practised. They may even be aggravated, in that chopping machinery and attendant mechanics are needed, in addition to extra labourers for transferring the manure from pen to pit.

On the other hand, synthetic manure making is less exacting. Provided adequate water supply is available, synthetic manure heaps may be constructed in fields where the manure is subsequently to be applied. Where the periods of rainy weather synchronize with the times when the waste vegetable material can be stacked for watering, considerable saving, however, may be effected. The main problem to be solved in the manufacture of synthetic manures is therefore the collecting and the wetting of the heap. Apart from the cost of the mixture itself, "Adco" manure offers great possibilities as a system of manure making on sugar cane estates.

Where distillery sludge or filter-press mud is used as a possible substitute for "Adco" mixture in the preparation of synthetic manure, the question of its transportation from factory to field is necessarily introduced as an additional factor.

There appears to be no reason why a critical examination based on accurate costing and aided by chemical analysis, should not be made of the various proposed methods for manufacturing synthetic manures from sugar cane field and factory waste materials, on those estates where facilities permit. By such means, the most economical procedure will readily be revealed. There is no doubt that the practice of growing sugar canes on land whose fertility is suffering progressive depletion through continuous cropping will eventually end in disaster.

Honduras—Another Little Known Sugar Country.

By ARTHUR H. ROSENFELD,

Consulting Technologist, American Sugar Cane League.

Tucked away on a narrow coastal plain between the azure waters of the Caribbean and the majestic Spanish Honduras mountains, rising to a height of as much as 8000 ft. from two to four or five miles back from the coast, lie extensive fields of excellent Cristalina cane developing under soil and climatic conditions which appear to be ideal for this old standard variety. Off the beaten track, in a beautiful setting, this industry, with its men and its methods and even factories transplanted from Louisiana within the last two decades, constitutes an interesting study for the casual tourist, the economist or the roving sugar man.

Location, topography and climate.—There are two main sugar developments in Spanish Honduras, both on the north coast of this tropical country. The larger and more modern one, i.e., more modern from the standpoint of the factory at least, is the " La Lima " estate of the Cuyamel Fruit Company, located near Puerto Cortez. The other development is the " Monte Cristo " property of the Honduras Sugar & Distilling Co., the sugar section of the widely flung properties of the Standard Fruit & Steamship Co., of New Orleans. Both of these industries have been developed on original banana plantations, the exploitation of the latter fruit being the principal business of both the Cuyamel and Standard Fruit Companies. The writer in this article will limit himself to a description of the " Monte Cristo " properties, located from 5 to 30 miles west of Ceiba, on which estates he recently had the privilege of spending a most enjoyable time.

While the surroundings are those of the typical humid tropics and in no way resemble the arid deserts surrounding the Peruvian canefields, the lay and formation of the land along this coast are very similar to the so-called coastal " valleys " situated in the deltas of the various rivers which find their way from the Andean slopes to the Pacific Ocean. Rainfall, however, more closely approximates to that of the eastern slope of the Andes. In the Honduras sugar sections, the mountains, running from east to west and rising quite abruptly from the coastal plain, form a natural obstacle to the southerly movement of the clouds, which results in an abundant precipitation along the northern coast, averaging from 90 to 100 ins. per annum. The following table of rainfall observations, the average of that on several farms of the " Monte Cristo " properties, will furnish an approximate idea of the normal distribution of the rainfall. The " dry " or crop season usually commences about the 1st of February and terminates the first part of July, although even during these months, as may be seen from the table, there is usually what in most sugar countries would be considered quite a high precipitation. The porous nature of the soil and the substrata, however, permit of this heavy rainfall being carried off very rapidly—in fact it is due only to this heavy and well distributed rainfall that good cane yields can be produced on these excessively well drained lands.

Soils.—The soils of these coastal plains are of alluvial origin, formed over what was originally the ocean beach by the silt brought down by the numerous rivers from above, and possess all of the well known advantages of this type of soil. Their greatest fault, in many cases, is their extreme thinness, which at times is but a few inches, which small amount of soil

over an extremely sieve-like substratum, is incapable of resisting dry weather for even a comparatively short period of time. There is practically no subsoil, most of the cultivable lands, varying from about 8 ins. to 2 to 3 ft. in thickness in extreme cases, being superimposed, as would be expected from their formation, on permeable strata of gravel or, occasionally, of sea sand. Not uncommonly there are outcroppings of gravel in more or less large areas amongst the thinner lands and, while attempts are sometimes made to grow cane on these areas where they occur within the confines of a plantation, there is really little chance of producing paying crops thereon and they would much better be left out of cane entirely, even if doing so would at times prevent the aesthetic squaring off of the fields. The extreme permeability of the substrata and the natural slope from the mountains to the sea make any necessity of artificial drainage, even in the rainiest season, very rare indeed. The soils are in general remarkably easy to work, the physical condition being exceptionally fine, and implements can generally be put into them within a day or so of very heavy rains. Likewise, there is comparatively little bad grass growth and most of the weeds are easily cultivated out.

Comparative Rainfall, 1925-26.

	1925.	1926.
January	4·33	24·65
February	7·20	10·17
March	0·82	10·79
April	0·79	0·54
May	10·78	2·58
June	5·16	3·78
July	4·31	4·84
August	6·77	4·23
September	6·78	6·24
October	4·44	7·71
November	21·38	24·88
December	18·63	5·37
Total	91·19	105·77

Probably the greatest defect of these soils, aside from their thinness, is their almost uniformly high acidity, the *pH* ratio ranging from as low as 4·2 to, in very rare cases, around the practically neutral figure of 7 to 7·2. The majority of the soils seem to range between *pH* 4·5 to 6·5. The use of lime is very much indicated here and this, in combination with the turning under of cow peas, which do very well on most of these soils and would probably do better yet in combination with liming, will very likely settle the majority of the fertilizing problems for many years to come.

Although the physical and chemical properties of these soils will vary to some extent with the nature of the rocks over which the streams forming them have flowed and with the rate of fall of the rivers and conformation of the land, the proportions of sand and clay in most of the soils do not vary greatly, even though there are occasional small areas of quite distinct quality from the average. Most of the soils may be classified as sandy loams. Occasionally there are found some slight admixtures of red clay and even small outcroppings of a stiff white clay formation.

Preparation and planting.—Outside of Peru it is doubtful if there is any place in the world where the preparation of land for sugar cane is carried out along lines of such a high scale of excellence as on these properties.

A considerable amount of the heavier work of preparation is done with large Holt caterpillar tractors.

In preparing new land for cane, which is usually what is known as *huamil*, or old banana land on which the bush has been allowed to grow for several years, the bush must first be cut down and then all trees felled and cut up in lengths suitable for convenient hauling off by tractors or mules after the fire has passed through the cut. Careful inspection is then made of the surroundings and steps taken to avoid any damage from the burning of the trash, which is the next step in clearing. Stumps are then dug out or cut to at least a foot below the surface, to avoid eventual difficulties in ploughing. This stumping is the most difficult and expensive part of the land clearing.

There are always certain parts of the debris which do not burn well, either on account of the fact that they were not well dried out or because the fire passed over them too quickly. These unburnt portions of brush are then either piled up and reburnt or loaded on to carts and hauled off at the time that the stumps are carried out. This leaves the land fairly clean, except for the unburnt trees, which the tractors or mules may now enter and remove, leaving the cleared land ready for its first ploughing.

Two ploughings and harrowings are generally given to these lands, which leave them as a rule in the condition of a well spaded plot, very much as the Peruvian cane soils are left after their deeper ploughing with cable ploughs. The fields are then laid off and the rows marked off with a share plough, usually at 6½ ft. The rows are deepened with a large double mouldboard plough, with wings, opening a wide furrow into which the finely pulverized soil has fallen to some extent, leaving an absolutely ideal seedbed.

The seed, which is carefully selected and always planted in an ideally fresh condition, the seed cutters never being allowed to get much ahead of the planters, is planted according to the Louisiana continuous row system, but only about half the amount of seed employed—one running row with a small lap. It is usually cut to 18 or 20 in. pieces after being laid in the row, and two seed pieces are always planted at the ends of the rows. The cane is covered with around 3 ins. of dirt by 7 in. single-mule ploughs. Men are are sent behind the ploughs with hoes to bury any seed left uncovered by the ploughs.

Cultivation and harvest.—This plant cane is then left until the first shoots begin to show, when a triangular tooth harrow is run down the rows to spread out any excess of dirt over the cane and remove the superficial weeds. About three weeks later little Planet Jr. 5-tooth cultivators are sent along the middles to keep down the grass. When around 18 ins. in height a little dirt is thrown from the rows to the middles and, while "on the offbar furrow," the rows are usually cleaned of grass with hoes. Reversible disc-harrows are then sent down the middles, restoring almost flat cultivation, and later dirt is returned to the rows with share ploughs. From this period on until the cane is closed almost all cultivation is given with the disc harrows, very little dirting up of the rows being employed.

The cultivation of stubble cane—and as many as nine stubble crops are occasionally taken off on the deeper lands—is similar to that of the plant after the trash has been burnt. The cane is allowed to sprout until the rows are well marked, when the "middles are wrapped" and the rows offbarred with share ploughs, i.e., two furrows are run down the centre of the middles and then two close to the cane, throwing the dirt toward the middles. The cane is usually left "on the offbar furrow" not over 15 days, when the

middles are disc-harrowed as with the plant and a little dirt returned to the rows with share ploughs.

The middles are again broken out when the cane has had about six months' growth and is beginnning to shade the ground, the dirt being thrown to the cane. A thorough and final harrowing is generally given then and, if there is considerable grass in the cane, a final weeding with *machetes*—almost always done by contractors.

Cutting and delivery of the cane is well co-ordinated and the cane usually reaches the mill within 48 hours after cutting. Stumps are usually left unnecessarily high, but Mr. DUNSTONE, the present efficient manager, assures me that, with the introduction of the tonnage system of cutting instead of the old day system, he has been able to materially improve the type of cutting, as the peons now realize that it is to their advantage to cut as low as possible and thereby obtain so much more weight. On the task basis the course of least resistance is followed and the cane cut too high.

Insects and diseases.—Although there have been reports in past seasons of very heavy infestation with the moth stalk borer (*Diatraea saccharalis* Fabr.), the writer found such an extremely light infestation at the time of his visit that it was negligible. The brevity of his stay and the absence of any noticeable infestation by the borer made it impossible for him to determine whether or no the decrease in borer infestation is due to a number of natural enemies, but conditions would indicate that this is the case.

Grasshoppers (*Schistocerca sp.*) occur abundantly at times, due to heavy migrations from the interior at intervals of several years, and during these periods of abundance always do considerable damage and even totally destroy some young plantings, making much replanting necessary. They are combated by the usual methods employed against the hopper stages in countries where these insects constitute a scourge—trenching, burning, etc.

To the writer's great surprise, he was able to find no trace of mosaic disease on these properties, so that this section of Honduras at least will have to be added to the very reduced list of honour of cane sections not having this dread enemy in their midst. This condition is undoubtedly due to the fact that there have been practically no importations of varieties into these properties for many years and it is to be hoped that the management will be extremely circumspect in this regard in the future.

No trace of gummosis could be found, either, about the only noticeable disease being occasional areas lightly infected with *Helminthosporium* leaf spot, to which Cristalina is not particularly susceptible. Red rot of the leaf sheath occurs commonly on the stonier, thinner soil areas where the cane has not developed well, but can hardly be found in the better grown fields.

Production.—Yields of cane per acre vary from around 15 to 50 odd tons per acre, depending on whether the thinner, more gravelly lands are cultivated or whether the plantings are on the superior and deeper soils. It seems to the writer that, by eliminating the poorer lands and concentrating only on the better ones, of which there are large areas available, and by correcting and maintaining the fertility of these through the use of leguminous green manures and liming, average yields can quite easily be brought up to 35 to 40 tons per acre of cane of very good sugar content, the latter running just about parallel with Cuban juices at corresponding periods of the year.

Conclusion.—As regards the state of development of the Honduras sugar industry on the whole, it compares most favourably with many of its larger and better-known competitors, whereas in soil preparation and cul-

tivation there are very few sugar countries that can compare with Honduras on a favourable basis. When the present period of wild over-production has passed and a little higher range of prices has been established for sugar, as will undoubtedly come to pass within a comparatively short time as world consumption increases at a faster rate than production, the writer has no hesitancy in predicting that the Honduras sugar industry will develop in accordance with the exceptionally favourable conditions surrounding it in many ways.

Determination of the Amount of Sulphur Dioxide in Mauritius Direct Consumption Sugars.

By LOUIS BAISSAC, F.C.S.,
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That sulphurous acid is present in direct consumption sugars obtained by sulpho-defecation is a fact which has long been known, but no one has heeded it, the quantities being so small. Attention however, has recently been directed to its presence by the new Public Health (Preservatives in Food, etc.) Regulations of the United Kingdom, dating from the 1st of January last. In December, 1926, the Sugar Syndicate of Mauritius applied to the Department of Agriculture to know what to do on the subject of our white direct consumption sugars, and the writer took up the matter.

Seeing that there is no official method of determining sulphurous acid in sugars, it was necessary to find one which could be adapted to our product. In some work published by Dr. F. W. ZERBAN, in Louisiana, in 1908, the conclusion was reached that in certain cases direct determination by means of iodine solution gave very satisfactory results. However, when dealing with sugars, Dr. ZERBAN did not give the *modus operandi* which he followed.

Firstly, therefore it was desirable to make certain that pure sugar is without influence on iodine solution. In doing this, refined sugars made from cane and from beet were employed. In these two cases, in a solution containing 50 grms. of sugar, 10 c.c. of sulphuric acid (30 per cent.) and a little starch indicator, the first drop of standard iodine solution, corresponding to 1 mgrm. of SO_2 per c.c., gave a blue colour which persisted several minutes. The second point to establish was the correlation between the direct iodometric and the distillation methods, which latter is the official American procedure for the determination of sulphurous acid in food products,[1] and was the one employed by Dr. ZERBAN in 1908.

METHODS USED.

Iodometric : 100 grms. of sugar dissolved in 300 c.c. of water, 10 c.c. of sulphuric acid (30 per cent.) 2 or 3 c.c. of starch solution (1 per cent.). The standard iodine solution was added rapidly, stopping when a blue colour appeared, which persisted after 2 to 3 minutes. This determination can be carried out very quickly, and when repeated in duplicate or triplicate gave identical figures.

Distillation : 200 to 200 grms. of the sugar (depending on the sulphur dioxide content), dissolved in 1000 c.c. of water which has been boiled a few minutes, were placed in a distillation flask connected with a Liebig condenser, the extremity of which entered an Erlenmeyer flask, containing saturated

[1] "Official and Tentative Methods of Analysis of the A.O.A.C." Second Edition, page 185.

bromine water. About 1 grm. of sodium bicarbonate was also placed in the distillation flask, which was closed by a two-holed stopper, in which were placed a tap funnel and the bent tube of the condenser. Then 5 c.c. of syrupy phosphoric acid were introduced into the distillation flask, the contents of which were boiled until about 300 c.c. of distillate had passed over. The excess of bromine in the distillate was expelled by boiling; 5 c.c. of hydrochloric acid (25 per cent.) were added, and some barium chloride solution (10 per cent.). This liquid was boiled; then, after standing for 18 hours, the precipitate was filtered off, calcined, and weighed. The weight of the precipitate $\times$ 0·2747, and brought to 100 parts, gave the weight of SO_2 present in the sugar. A blank determination gave 1 mgrm. of barium sulphate, which weight was deducted from that of the precipitates found in each determination.

On 10 analyses of sugar of different origins the average between the two methods was: By iodine, 0·00446 grm. and by distillation 0·00445 grm. of SO_2 per 100 grms. of the sugar; in other words, 44·6 and 44·5 parts per million respectively, the individual differences not having exceeded 1 part per million, one way or the other. One concludes, therefore, that for white direct consumption Mauritius sugars the determination of sulphur dioxide by the direct iodometric method is very satisfactory.

Results Obtained.

Using this method, 55 sugars were analysed, these samples in fact representing the product of practically all the factories in Mauritius. In 50 of these the quantity of sulphur dioxide (SO_2) varied from 10 to 70 parts per million, which latter is the extreme limit permissible, and only in five cases was this figure exceeded. Sugars, it was observed, coming from factories in which the evaporator syrup (clairce) was decanted after the addition of phosphoric acid contained the least sulphur dioxide, and the quantity of SO_2 appeared to vary inversely to the quantity of phosphoric acid employed. Sugars of the extra fine type, or Grade A, obtained by the decantation of the evaporator syrup without using phosphoric acid, with or without the addition of sodium hydrosulphite to the vacuum pan, contained more sulphur dioxide than those produced with phosphoric acid, though the quantity never exceeded 70 parts per million.

Only five sugars, originating from three factories in which decantation is not performed at all, gave figures varying from 72 to 122 parts per million. But these sugars were of Grade B quality, which does not pass into direct consumption. It would seem evident therefore that the decantation of the syrup plays an important rôle in the total sulphur dioxide contained in Mauritius sugars, the sulphites precipitated during the evaporation being thus eliminated. Further, the phosphoric acid displaces sulphurous acid, and thus assists in obtaining a sugar containing only a minimum of this body. One may therefore conclude by stating that Mauritius white sugars conform in general to the demands of the new Public Health Regulation of the United Kingdom. We give credit to Mr. Octave d'Hotman, Chemist at La Rosalie, who has rendered considerable assistance in all the analytical work here involved.

Juice as expressed from the beet rapidly darkens as the result of the action of certain oxidizing enzymes. But according to a recent patent specification,[1] this can be prevented by the addition of a solution of monocalcium phosphate, either before extracting or pressing, or else to the juice as it issues from the press. This addition may also be made on the technical scale to the juice in the diffusion process of extracting juice.

[1] M. J. H. Savary. French Patent, 612, 946.

Application of the Dye Test to Sugar-House Products, and the Relation between Certain Measurements and the Refining Quality of Raw Cane Sugar.[1]

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Investigation of the effect of colloids upon the refining quality[2] of raw cane sugars is one of the most important subjects in the refining industry to-day. In order to make a study of colloids in raw sugars it is necessary to have methods of measurements which are reasonably accurate and which can be manipulated fairly easily. As a preliminary step in learning more about the colloids in sugar liquors such methods as ultrafiltration and measurement of filtrability have been developed and used as laboratory tests. Valuable information has thus been obtained. The dye test described in a recent publication[3] by the authors has also been applied to cane sugar refinery products and the data compared with the results of ultrafiltration and filtrability determinations. The present investigation was made possible through the courtesy of officials of the Savannah Sugar Refining Corporation, who co-operated with us throughout the work.

A number of samples were taken from lots of raw sugar which had been observed in refinery operations to produce melts of poor, medium and good filtering characteristics. The filtrability of these samples was determined by means of the Dawson pressure filter. This apparatus is designed to maintain close control of pressure and temperature, and, by means of a motor-operated stirrer, to keep the filter medium (infusorial earth) in uniform suspension during the filtration period. The pressure may be increased gradually or it may be maintained at the same value during the entire period.

Several filtrations were made on each sample of sugar, varying the proportion of infusorial earth in four steps from 2·5 grms. to 10·0 grms. per 2000 grms. of 50° Brix sugar solution and keeping all other factors constant, the pressure being kept constant at 20 lbs. by means of a needle valve control. The period of observation of filtration was 30 mins. in each instance and the temperature was 85° C. The filtrates collected at the end of 30 mins. were weighed immediately and the weights were plotted graphically against the weights of infusorial earth used per constant weight of raw sugar solution. These samples were not subjected to affination treatment before making the filtration measurements, but the excellent correlation between the laboratory test data and the refinery operating observations, indicates that this initial step is not essential in determining the *comparative* refining values of raw sugars by laboratory tests.

For ultrafiltration, a 20° Brix solution was prepared from 300 grms. of each raw sugar sample, and this was filtered through filter-paper[4] in order to make an approximate separation of particles larger than colloidal dimensions. The solution was then ultrafiltered through the standard colloidon membranes. Sugar was washed out from the colloid residue remaining in water suspension above the membrane until an α-naphthol test of the ultrafiltrate was negative. This washed residue was transferred

[1] Paper (here abridged) presented before the Sugar Division at the 72nd Meeting of the American Chemical Society, Philadelphia, Pa., September 6th to 11th, 1926.

[2] In this article reference is made exclusively to the influence of colloids on refining quality and the influence of salts is not considered. [3] *I.S.J.*, 1926, 28, 23, 97, 137.

[4] SCHLEICHER and SCHÜLL No. 588 Faltenfilter. The separation of particles of greater size than the arbitrary 0·1μ in diameter by means of paper filters is, of course, only approximate.

to a platinum dish and evaporated and dried on a hot plate at 105° C. and weighed. The weights of colloidal material obtained in this manner are recorded in column 3 of *Table II.*

Table I.

FILTRABILITY OF RAW CANE SUGARS.

Filter medium: infusorial earth, grms.	Weight of filtrate in grms. (50° Brix solution) Pressure 20 lbs. Temperature 85° C. Time 30 minutes. Raw sugar sample number.							
	110	120	310	410	150	160	707	180
2·5	6·5	3·0	1·0	0·0	0·0	0·0	0·0	0·0
5·0	46·0	45·0	40·0	38·0	13·0	10·0	9·0	5·0
7·5	102·0	95·0	93·0	78·0	55·0	31·0	29·0	24·0
10·0	175·0	164·0	160·0	139·0	94·0	73·0	66·0	57·0

The dye test is based on the neutralization of electrically charged particles in aqueous suspension by means of a dye of opposite charge. It provides an approximate quantitative measure of electrically charged particles of colloidal dimensions. In making the test, 5 grms. of raw sugar were dissolved in 25 c.c. of warm neutral water and then filtered through filter paper, washing thoroughly and diluting the filtrate to 100 c.c. In nearly all cases the *pH* of this solution was approximately 6·0. The solution was cooled to room temperature, the dye solution was added and the mixture was tested in an ultramicroscopic cataphoresis cell. The dye Night Blue was used in making all dye tests.

MATTSON[1] has described a convenient ultramicroscopic cataphoresis cell. Because of the electro-osmotic movement of an aqueous solution in a capillary tube it is desirable, in order to measure the true speed of the colloid particles, to focus the microscope at a point in the capillary of the cataphoresis cell at which the electro-osmotic movement of the liquid is nil. This point, as found by MATTSON, is obtained by focussing at a distance of $0{\cdot}293 \times r$ (r = radius of capillary) below the upper wall of the capillary.

Ten c.c. of the standard dye solution can be safely added at first and if necessary more dye can be added later. The volume of standard dye solution required varies from 10 c.c. to 25 c.c., depending on the grade of raw sugar. Assuming, for instance, that 25 c.c. of dye solution is required to neutralize exactly the electric charges of the colloid particles in 5 grms. of raw sugar, the weight of dye (25 c.c. of dye solution contain 25 mgrms. of dye) is divided by the weight of sugar and the quotient multiplied by 100,000. This gives a whole number (500 in this case), which is termed the " dye value " of that particular lot of raw sugar. The dye values of raw sugars range from about 200 to 500, the lower values indicating lower colloid contents than the higher values.

Table II gives the dye values, weights of colloids by ultrafiltration, and filtrability based on refinery observations for several samples of raw sugar. A comparison of the filtration curves with observations of refinery operation indicates that samples Nos. 110, 120 and 310 may be classed as good filtering sugars, samples Nos. 410, 150 and 160 as medium filtering sugars, and samples Nos. 707 and 180 as poor filtering sugars. The dye values vary in a manner which is in general inversely proportional to the filtration rates. *On the above basis of classification the best filtering sugars have a dye value of* 250 *to* 300, *while the poorest filtering sugars have a dye value of* 440 *to* 480. The data in *Table II* show that the weight of colloids by ultrafiltration varies at about the same rate as the dye value and is in

[1] *Kolloidchem. Beihefte*, 1922, 14, 309.

general inversely proportional to the filtrability. The samples are grouped in the order of decreasing filtrability and increasing dye value and colloid content by ultrafiltration.

Table II.

COMPARISON OF FILTRABILITY, DYE VALUE AND WEIGHT OF COLLOIDAL MATERIAL BY ULTRAFILTRATION.

Sugar sample Number.	Dye value (per 100,000).	Weight of colloids by ultra-filtration.	Filtrability (refinery observation).
110	250	0·371	Good
120	300	0·504	"
310	300	0·492	"
410	360	0·521	Medium
150	400	—	"
160	420	0·534	"
707	440	—	Poor
180	480	0·720	"

These three methods of investigation of the refining quality of raw sugar gave results which were in harmony. They may, therefore, be used either singly or in combination. The quickest method is the dye test which, after a little practice, can be made in a few minutes. The assembly of an ultramicroscopic and cataphoresis equipment has been described[1] by the authors. The apparatus is quite practicable for use in a sugar refinery laboratory and can be obtained at moderate cost. The dye test has been applied to samples of raw sugar representing over 100 different "marks" (each from a different raw sugar factory) and the dye values have been grouped according to the scheme followed in *Table II*. When the sugars were grouped by dye values representing good, medium and poor filtering sugars, the results agreed very well with refinery observations of these sugars.

In an investigation of the filtrability of Hawaiian raw sugar, SMITH[2] found that the "non-settling matter in raw sugars may be considered the major factor affecting filtration rate." Following SMITH's method of approximately separating "settling" and "non-settling" insoluble material in raw sugars, two samples of linen cloth were obtained with fairly uniform mesh of about 0·75 mm. for one and 0·15 mm. for the other. These cloths represent about the upper and lower limits of the size of mesh used by SMITH. Solutions of several samples of raw sugar were filtered through these cloths and also through ordinary filter-paper, and the dye test was made on the solutions before and after filtration.

No difference in dye values between the raw sugar solutions before and after filtration was detected, even in the case of sugar solutions filtered through filter-paper. This is conclusive evidence that the material removed by filtration through paper or linen either had no electric charge, or was so nearly neutral that it was impossible to detect an electric charge by the dye test. Thus practically electrically neutral suspended material, which is of relatively large dimension, has little or no effect on the filtrability of raw sugar melts. These results indicate that practically all of that portion of the suspended material which passed through filter-paper and most of that which passed through linen cloth was colloidal in character and carried an electric charge, the neutralization of this charge causing flocculation. This portion of the suspended material is largely non-settling, is primarily responsible for the turbidity of a solution of the raw sugar and causes most of the trouble in retarding filtration.

[1] *I.S.J.* 1926, 28, 97, 137. [2] *I.S.J.*, 1924, 266, 322.

Numerous observations of the behaviour of various lots of good and poor filtering raw sugars at successive stages of the refining process indicate that the same conditions that cause poor filtrability of a raw sugar also cause an earlier exhaustion of the bonechar. This is to be expected since colloids play an important rôle in each of these operations. This will be illustrated by an account of the behaviour of a single lot of raw sugar (No. 707 in this investigation), which was observed carefully at all stages through the refinery, and which constituted an apparent exception to the general rule in that the sugar had a comparatively high dye value and a practically normal rate of filtration. While this raw sugar was passing through the refinery, the rate of flow through the Sweetland presses and bonechar filters was normal, but there was an increase of time in sweetening off. The massecuites appeared dull and had a poor colour. This immediately suggested the probability that the colloidal material present was highly dispersed and was passing through the presses without appreciably influencing the rate of filtration.

An examination was made of all liquors at the various stages of the process. The Sweetland press liquor gave a high dye value (106), as did also the massecuites. The dye value of the affination syrup was very high (2212). Likewise, the dye value of the washed raw sugar (165) was higher than usual for washed raw sugar in this refinery. When the liquors from the Sweetland presses show a very high dye value, it is certain that a considerable quantity of colloidal material is passing to the bonechar filters, thus causing the bonechar to become exhausted more rapidly.

Comparison of our data with the refinery records for this run with raw sugar No. 707 showed: (1) That colloidal material was not adequately removed in the earlier stages of the refining process and that a considerable proportion passed on to the white sugar massecuites, giving them an off colour, and a dull appearance; (2) that there was an increase in the time required for sweetening off the bonechar filters. The average time for sweetening off all the bonechar filters for the three days this lot of raw sugar was being run through the refinery was 10 hours. The raw sugar refined just prior to this particular lot of sugar had a dye value of 320 and required an average of 7·37 hours for sweetening off the char filters, a difference of 2·63 hours. This represents a considerable loss of time which increases the refining cost. The laboratory tests predicted difficulty with this lot of raw sugar (No. 707) long before we were able to find out anything about it from actual refining operation.

The dye test has been systematically applied from day to day to all refinery sugar liquors, massecuites and white sugars and has given some valuable information regarding the quantities of colloidal material present. The test has proved useful both for grouping raw sugars from the standpoint of refining quality, and for studying the rate of exhaustion of bonechar under various conditions.

"The amount of frost required to kill a beet depends on suddenness of freezing, concentration of the plant's sap, and the suddenness of thawing and conditions under which thawing takes place. In speaking of frost effects on beets the Germans use two words: *erfrieren* to freeze, to die from cold; and *erfroren*, frozen—benumbed with cold. In the latter case the moisture in the intercellular spaces may freeze so as to make the plant stiff. This water freezes at a higher temperature than the cell contents so that frosts of this kind may not kill the plants. Harder frosts actually freeze the cell contents, destroy life and rupture the cells thus breaking down the tissue of the plant. A gradual lowering of temperature may not freeze the plants even though the same low temperature coming on suddenly might do so."[1]

[1] Asa C. Maxson in *Through the Leaves*, June, 1927, page 269.

Photo-Electric Indicators for Polarimeters.

To have some means of obtaining polarimetric indications independently of personal ocular readings would certainly be advantageous. Several contributions which have recently appeared show the possibilities of modern photo-electric devices in this direction, these being here summarized :—

Strelkow's Device.

The first is by S. A. Strelkow[1] who describes a combination of the polarimeter with a photo-electric metric device by means of which, on laying the observation tube in the well of the instrument as usual, the index of the galvanometer immediately records the sugar percentage in the solution examined. This apparatus is claimed to be completely automatic, rapid, and accurate, but no results obtained with it are recorded by this Russian author, and especially no data on the degree of accuracy and the rapidity of indication are given. His description of the method and apparatus employed are nevertheless of much interest.

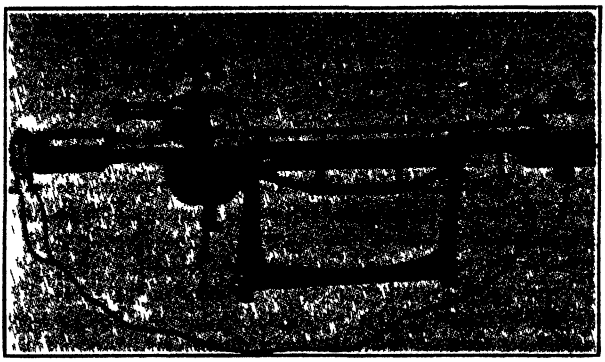

Fig. 1.

As is seen in the illustration, instead of the ocular attached to the ordinary half-shadow polarimeter, a metallic cylindrical case provided with an accurate galvanometer is screwed. This case represents a cylindrical chamber on the walls of which are fixed two semi-circular isolated selenium cells, these corresponding to the actual image of the two half-circles visible through the polarimetric tube. Instead of the ocular, there is a lens in the case which throws on the selenium plates the actual image of the half-circles, the selenium plates therefore being illuminated with light of varying intensity depending on the position of the compensator. The case is covered internally with ebonite, this also protecting the selenium plates from the changes in temperature outside.

The case has two clamps for the connexion of the galvanic elements; while for the selenium plates the clamps, and the galvanometer are mounted in the case after the principle of the Wheatstone bridge. With equal illumination of the selenium plates, the needle remains at zero point, but with unequal illumination the needle deviates to the right or the left according to which half is the darker. At the other end of the polarimeter, a second circular case containing an electric lamp is attached, and to the sides of this are placed two

[1] *Bulletin of the Sugar Trust* (Russia), 1926, 2, 55; through *Centr. Zuckerind.*, 1927, 35, 128; 1927, 35, 249.

bismuth-antimony heating elements connected to one another through the wall of the case. The half-watt electric lamp used gives sufficient heat to bring into action the thermo-electric couple which is connected by means of a wire to the clamps of the first cylindrical case.

Miss Dickes' Work.

In a letter to the Editor of *Nature*,[1] Joseph Kenyon, of Battersea Polytechnic, London, gives a brief account of the work of one of his students, Miss Winifred E. Dickes, on the use of selenium cells and photo-electric devices, as applied to the polarimeter.

In its essentials the apparatus consists of a spectrometer, for the collimator of which is substituted a polarimeter without eye-piece or half-shadow device but having a slit over the polarizer diaphragm and an electrical photometer behind a slit in the eye-piece of the telescope. An additional eyepiece is placed at right angles to the axis of the telescope for observing the line of the spectrum employed. Half of the field of this eyepiece is fluorescent for convenience in setting when making determinations in the ultra-violet regions. The photometer used is a selenium or alkali metal cell, and valve amplification is being tried. Two positions are found about 90° apart, which give the same current. The mean of the two readings so found gives an accurate value for a minimum or maximum according to choice, though the minimum is slightly to be preferred. The readings 90° apart are taken repeatedly, and are averaged in the same way as pointer readings used in weighing. With a selenium cell these observations are made at fixed time intervals to allow for the characteristic small secular variation in the current.

Since there is no half-shadow device, the whole of the light can be utilized by the photometer. A magnified image of the polarimeter slit is used for the photometer, in order that a larger (that is, a more sensitive) selenium cell may be used. At the end of 1924 with a rough arrangement, an accuracy had been obtained of 0·01° in the red end of the spectrum, and 0·1° in the violet. There is reason to hope that a considerably greater accuracy may be obtained, and it is proposed to investigate its adaption to an automatic or recording polarimeter.

Von Halban and Seidentopf's Patent.

Prof. H. von Halban, of the Deutsche Gold-und Silber-Scheideanstalt, Frankfurt a. M., Germany[2] points out in reference to the above contribution that he and K. Seidentopf in July, 1922, patented a method of photo-electric polarimetry,[3] which was taken up by E. Winkel, of Göttingen. The best results were obtained with an arrangement in which the variation of luminosity of the source (mercury lamp) was compensated by using two cells.[4] The light emerging from a monochromator was split up by a quartz plate, the transmitted ray passing through the polarimeter on a potassium photo-electric cell with argon filling, while the reflected rays fell direct on a similar cell. The voltages on the two cells were so distributed that the photo-electric currents balanced, as shown by a single fibre electrometer. On introducing vessels with the solution to be tested into the two beams, the loss of light was cancelled by absorption, leaving only the change due to polarization, which was then compensated by rotation of the nicol. Readings could thus be made with an accuracy of 0·01° in the strong ultra-violet lines, and rather less accurately in the feeble lines.

[1] 1926, **117**, No. 2939, 304.
[2] *Nature*, 1927, **119**, No. 2985, 86. [3] German Patent, 386, 537.
[4] *Zeitsch. Phys. Chem.*, 1920, **96**, 214 ; 1922, **100**, 208.

STANEK AND SANDERA'S METHOD.

The fourth contribution is by VL. STANEK and K. SANDERA, of the Sugar Experiment Station, Prague,[1] who mention that the first of them has been working on this subject for the past 25 years in collaboration with the firm of J. J. Fric, but without result. Now, however, the question of the objective measurement of the intensity of light has entered a new stage, due to the improvement of photo-electric cells and of thermo-couples. Due also to the considerable amount of work which has been done on the amplification of weak continuous currents, this theme (formerly entirely theoretical) is now in the practical field. Wireless picture reproduction, as well as television, have contributed much to the present state of practice.

The problem of the electrometric determination of the intensity of light can be attacked by two methods (excluding the use of sluggish selenium cells) : (1) by means of a thermo-pile as described by W. W. COBLENTZ[2] and W. B. EMERSON, a method which is not rapid (2) the use of light-sensitive cells, the method used by us, which will now be described. Light-sensitive cells owe their origin to the discovery by HALLWACHS, who showed that negatively-laden bodies exposed to ultra-violet light lose negative electricity. Later experiments of ELSTER and GEITEL showed that electrons are split off with alkali metals even on exposure to visible light, the number being directly proportional to the intensity of that light. A cell thus results, which follows the variations of the light intensity without appreciable retardation, a point of the greatest importance for polarimetric measurements.

Referring to the illustration, the photo-cell consists of a glass vessel exhausted of air having an annular wire as anode this being connected with the positive pole of a source of current, while the cathode consisting of an alkali metal (e.g., potassium) covers a part of the inner glass wall. When the cathode is illuminated, electrons are split off, the number varying according to the change in the illumination. If the cell is provided with a circular diaphragm, as in polarimetric measurements, its sensitivity and therefore also the intensity of the resulting current, become much smaller.

Direct measurement of such weak electric currents is naturally difficult and can only be made with the help of a highly sensitive mirror-galvanometer or an electrometer, methods which in practice are inconvenient and tedious. For this reason the current to be measured must be amplified before measurement in order to be able to use an aperiodic needle galvanometer. G. DU PREL[3] has studied this amplification of photo-currents by means of modern valves, using rubidium cells. He, moreover, uses two nicols for effecting the variation of the light, and therefore he has actually been working with a photo-electric polarimeter, though without having in view the possibility of this application to the object under consideration.[4]

It remains to mention the work on the amplification of the photo-current by means of double grid valves.[5] STRÖMGREN[6] has published work on particularly high amplification by means of double grid valves and several ordinary valves, which application was used for photo-electric registration of star transits.

[1] *Zeitsch. Zuckerind. Czecho.*, 1927, 51, No. 25, 245-248.
[2] *Sc. Paper*, No. 261, *Bur. of S.*, 1926.
[3] Ann. der Phys., 1923, 70, 199.
[4] *Naturwissen.*, 1921, 9, 359 and 389.
[5] *Revue d'Optique*, 1926, 5, 10, 408.
[6] *Astr. Nachr. Bd.*, 226, 1925, 82.

Photo-Electric Indicators for Polarimeters.

A simple but not very sensitive scheme is now given (as a preliminary report) for the application of light sensitive cells to objective polarimetric measurements. The polarimeter, P, has only two nicols, so that the setting of the zero-point results only by the determination of the minimum intensity of light; this light enters the photo-electric cell, A, the current so arising being amplified by valve R, and read on the galvanometer G. The position of the crossed nicols is determined from the minimum of the throws of the galvanometer needle. The amplification system used is a modification of the methods of DU PREL[1] and of ALLEN.[2] An amplification of 10^4 was reached with this apparatus, which is distinctly less than that obtained by DU PREL, which disadvantage was compensated by the simplicity and the convenience of the arrangement. It is true that the accuracy reached of 1° leaves much to be desired, though this can doubtless be improved by further amplification.

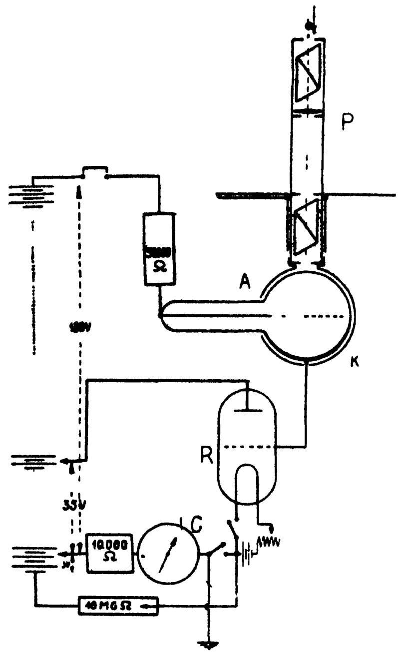

FIG. 2.

MISS DICKES' SUGGESTION.

Finally, Miss DICKES comments on the above article of STANEK and SANDERA[3] pointing out that if their apparatus were used by them with her method its sensitivity would be increased more than 50 times. She goes on to show that if these authors had worked at the 45° position they would have obtained an accuracy of 0·02°, instead of one only of 1°. But about 10 mins. would be required for a reading, which makes the method too slow for the testing of sugar solutions industrially. However, if the apparatus is used merely as a saccharimeter, the advantages of both methods might be united by using the photo-electric system with a quartz wedge compensation polarimeter. As this apparatus has a constant zero, it would only be necessary to make the analyser capable of being turned to stops placed at exactly equal angles of about 45° on either side of the zero. After that, the method would be as follows: The galvanometer is read first with the Nicol on one side and then on the other. Following this the quartz wedge is moved until one obtains the average galvanometer reading. This is to be repeated until the same readings are obtained on both sides; then the concentration is read from the Ventzke scale. Mono-chromatic light is not necessary, and the sensitivity can be increased by the use of a bright "Pointalite."

OAHU SUGAR Co., has the record for last crop in sugar production in Hawaii with the figure of 10·9 tons per acre; and the MAUI AGRICULTURAL Co. obtained one of 8·8.

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[1] *Loc. cit.* [2] "Photo-Electricity" (1926).
[3] *Zeitsch. Zuckerind. Czecho.*, 1927, 51, No. 34, 379-380.

Jamaica.

Department of Agriculture Report for 1926.

The annual report of the Director of Agriculture (Mr. H. H. Cousins) on the work of the Jamaica Department of Science and Agriculture for 1926 states that the year in question has, on the whole, been favourable for agricultural production. For the first six months drought conditions were acute in many parts of the island, but the latter half of the year was favoured by well-distributed rainfall conducive to high productivity of all stable crops.

The sugar estates have recently developed a keener interest in the testing of new canes and in the use of artificial manures. Definite results have already been obtained to show that Uba and BH 10 (12) are two outstanding canes that will serve to increase the production of sugar in Jamaica. A large number of new canes have been obtained for trial at the Hope Experiment Station and the best of these are being issued to the estates. The condition as to mosaic disease may be regarded as satisfactory ; but small growers of cane appear to be disinclined to take the necessary measures to stamp it out, and it is apparent that the substitution of Uba or some other resistant variety of cane for that at present grown is necessary if mosaic is to be controlled on the small holdings.

Details published by the Superintendent of Agriculture as to the achievements of the two-above mentioned varieties show that very promising results have been obtained with them. BH 10 (12) has now been extensively planted. On one estate a field of 15 acres gave an average tonnage of 43 tons to the acre, as compared with 29 tons for White Transparent. Since, in addition, the sucrose content was 20 per cent. greater, the total gain in favour of the BH 10 (12) cane was nearly 70 per cent. The Uba cane continues to be a prime favourite with the planters in spite of very pessimistic forebodings. It has fully justified its introduction and has been the major factor in the solution of the mosaic trouble. It has also distinctly increased the crops in some places as it has been found to do admirably on certain lands hitherto unsuited to other less hardy varieties. Thus on one estate three fields of Uba plant canes averaged 44 tons to the acre, one yielding 60 tons, while a comparative average for White Transparent under similar conditions was 28 tons. In ratoons Uba yielded 28 tons as compared with 22 tons for White Transparent. Tests were made at the same estate to determine the comparative loss of sugar from the two canes at different periods of time after cutting. It was found that Uba cut and left over for the weekend lost 11 per cent sucrose, the other cane losing only 6 per cent. This indicates the advisability of grinding Uba within 24 hours of cutting.

The Entomologist's report records attacks on the cane by Moth Borer (*Diatraea saccharalis*, F.), Mealy Bug (*Pseudococcus Sacch.*), the Yellow Aphid (*Sipha flavus*, F.), and West Indian Cane Fly (*Stenocranus sacchivorus*). This last fly caused a serious retardation of the plants in some districts, White Transparent and BH 10 (12) being especially affected ; on the other hand, Badila and Uba in the same localities were but slightly if at all touched by the pest.

The demand for Jamaica Rum during the year in question was quite poor, and it has become evident that the production of "common, clean" rums must be reduced till stocks have been considerably lowered. The very high duty on spirits in the United Kingdom exercises a check on the consumption of rum, and efforts are now being made in the interests of the West Indies to seek some amelioration of these conditions in the home trade.

Australia.

Statement showing the Production and Imports and Exports of Cane Sugar during the years 1901 to 1926.[1]

Year.	Production tons.	Imports tons.	Exports tons.
1901	—	98,519	4,738
1902	98,795	93,444	3,336
1903	111,659	91,615	2,365
1904	164,670	38,086	2,944
1905	172,242	24,965	11,158
1906	205,576	42,025	9,252
1907	214,244	6,201	18,260
1908	165,715	19,598	14,741
1909	146,470	99,774	8,051
1910	229,584	34,060	6,585
1911	190,595	33,275	6,552
1912	129,783	98,541	2,256
1913	266,267	74,901	3,419
1914	246,408	17,125	13,091
1915	159,681	22,510	7,181
1916	192,831	125,047	1,071
1917	324,260	63,936	1,347
1918	209,853	6,436	2,239
1919	162,298	103,337	2,314
1920	167,401	99,067	2,546
1921	299,465	84,470	29,409
1922	306,678	5,381	2,205
1923	281,859	2,868	8,404
1924	435,680	3,060	81,696
1925	522,344	340	159,096
1926	405,258	3,624	80,004
1927	400,000	—	—

NOTE.—The figures regarding production for the year 1901 to 1909 inclusive are for the sugar season commencing 1st April each year, while the trade figures refer to calendar years.

The production of beet sugar in 1926 was 2315 tons, and in 1925, 3017 tons.

Correspondence.

CUBA AND THE LEAGUE OF NATIONS.

TO THE EDITOR, "THE INTERNATIONAL SUGAR JOURNAL."

SIR,—In "Notes & Comments" in your July issue, under the title "The League of Nations and Sugar Production," you give us the interesting information that Cuba, that independent nation, through its representatives urges "that protective measures as applied by particular countries to sugar should be limited to assuring supplies for the *domestic* markets and should not stimulate surplus production for *foreign* markets, which generally leads to dumping."

In view of this proposal it would be interesting to know what is the domestic consumption of the Cuban Republic ; if we are to take it at its face value, we may now expect to hear of a further voluntary restriction of the Cuban production to the tune, this time, of a few million tons per annum. Or is this very sweet sauce only for the geese and not for the gander ?

Pernambuco, Yours interestedly,

August 20th, 1027. ALFRED WATTS.

[1] Taken from the Annual Report of the Australian Sugar Producers Association for 1926.

Publications Received.

Colour in the Sugar Industry. By H. H. Peters and F. P. Phelps. Department of Commerce; Bureau of Standards; Technologic Papers, No. 338. (Superintendent of Documents, Washington, D.C., U.S.A.) 1927. Price: 20 cents.

In the first part of this Paper the nomenclature and terminology of precision photometry are exposed, after which follows a discussion of the colorimetric clarification of turbid sugar solutions; of photometric observations and the calculation of results to a unit basis; and of the optical effect of different methods of clarification. A photometric study of absorption spectra of sugar solutions led to the discovery that any variation in chemical methods of preparation and clarification of solutions for an optical precision analysis causes, in turn, variations in transparency and observed light intensities. The true colour of the solute appears rather doubtful and seems to be obtainable only after continued and extended research.

The Lovibond Colour System. I. A Spectrophotometric Analysis of the Lovibond Glasses. K. S. Gibson and F. K. Harris. Department of Commerce; Bureau of Standards; Technologic Paper No. 547. (Superintendent of Documents, Washington, D.C., U.S.A.). 1927. Price: 15 cents.

Spectral transmissions for the Lovibond glasses from 380 to 750 mμ and the integral transmissions for sunlight are presented in the form of tables and of curves. The discussion following the presentation of these data touches on certain troubles found by users of the Lovibond system of colour grading, illustrating both the need for and the difficulties involved in the re-grading of the glasses themselves.

Measurement of Surface Tension. By N. Ernest Dorsey. Department of Commerce; Bureau of Standards; Scientific Paper, No. 540. (Superintendent of Documents, Washington, D.C., U.S.A.) 1927. Price: 15 cents.

This Paper presents a brief survey of the more important of the methods which have been employed in the measurement of surface tension, and indicates the precautions that must be observed in order to avoid certain errors which are frequently made. A bibliography of more than 100 selected papers is appended.

Determination of the Weight per Gallon of Blackstrap Molasses. C. F. Snyder and L. D. Hammond. Department of Commerce; Bureau of Standards, Technologic Paper No. 345. (Superintendent of Documents, Washington, D.C., U.S.A.) 1927. Price: 5 cents.

A torsion balance is used for determining the density of the molasses, one of of the beams being graduated in lbs. per gallon, from 10·8 to 12·05 in 0·01 lb. intervals.

The Polarimeter. By Vivian T. Saunders, M.A. (Adam Hilger, Ltd., London). 1927. Price: 1s. 6d.

This is a reprint of a lecture, illustrated by lantern slides here reproduced. This must be one of the clearest elementary accounts published of the science and application of polarimetry in general and saccharimetry in particular. It may highly be recommended to the student as an easy means of becoming introduced to a subject of so much interest and importance.

Commercial Determination of Sugar in the Beet. Arm. Le Docte. (The Sugar Manufacturers' Supply Co., Ltd., London). 1927. Gratis.

This is an English translation of the author's well-known and authoritative pamphlet "Dosage Commercial du Sucre dans la Betterave." It has been prepared for use in the British beet sugar industry, and by reason of the very clear manner in which the Sachs-Le Docte procedure is described and illustrated, it is a brochure likely to be much in demand.

Publications Received.

Manual of Sugar Companies, 1927. (Farr & Co., 90, Wall Street, New York.) Free on application.

This reference book, now in its eighth year, gives data on some 115 American companies engaged in the sugar industry, cane and beet, presenting their history, properties, production and dividends, a condensed balance sheet, and finally the names of officials and directors. It further presents statistics relating to sugar international production, a complete list of Cuban centrals, as well as Hawaiian and Porto Rican factories, and also a coloured map of the world showing cane and beet producing countries.

Thermometric Conversion Chart. Percy L. Marks, L.R.I.B.A. (Crosby Lockwood & Son, London.) 1927. Price: 3s. 6d.

The chart shows the tables of Fahrenheit, Centigrade, Réaumur and de l'Isle, and also absolute degrees, and forms a handy if not very accurate means of rapid conversion, a few preliminary remarks giving some information regarding these scales.

List of British Specifications Standard and Reports. C. B. 3002; Publication list No. 3, 1927. (British Engineering Standards Association, 28, Victoria Street, London, S.W. 1.) 1927.

Trade Notices.

We learn that the FARREL FOUNDRY & MACHINE Co. of Ansonia, Connecticut, the well known American sugar machinery manufacturers, are amalgamating with the Birmingham Iron Foundry of Derby, Connecticut, and the new concern is to be known as the FARREL-BIRMINGHAM COMPANY, INCORPORATED. The Birmingham Iron Foundry (who should not be confused with a similar-named firm at Birmingham, Alabama) are not builders of sugar machinery; but as a result of the amalgamation the added plant facilities of this engineering firm will permit the Farrel Foundry greatly to increase its ability to handle a larger volume of work for the sugar trade. No radical changes in the management of the new corporation are contemplated, and therefore a continuity of the conservative policies which have prevailed in the past is expected in the future.

The FULTON IRON WORKS COMPANY has just secured what is said to be one of the largest sugar mill contracts ever granted in the United States. This contract, which is with the Cia General Tabacos de Filipinas for the sum of approximately two million dollars relates to buildings and machinery for a complete cane sugar factory to be erected at Tarlac, Philippine Islands. It will be the largest factory in those islands and will naturally be equipped with the most modern machinery. The factory is to be ready for operation about the middle of 1928. Apart from the Philippines, the Fulton Co. has secured orders for complete milling plants in several Cuban centrals, and some substantial orders for milling machinery, for factories in Porto Rico, Pernambuco, and Mexico. To date the Company has sold some ninety Double Crushers since introducing this device to its customers twelve years ago.

The Director of Sugar Experiment Stations states that the approximate estimates of the different sugar mills in Queensland during July show an anticipated yield of 3½ million tons of cane, which should give, when crushed and manufactured, about 440,000 tons of sugar. Should these figures be realized this would be an excess of some 50,000 tons of raw sugar above last year's output, but will be much less than the production in 1925. On the whole the season has been very favourable this year, and the yield in the southern sugar districts will be considerably higher than last year. In New South Wales the output of raw sugar this season is expected to be 26,000 tons in addition.

Brevities.

At Raymond, Alberta, Canada, a plant (having 26 presses) has been installed for the exhaustion of molasses by means of the osmose process.

During 1926 Java sugar factories burnt 14 per cent. of the molasses produced,[1] thus supplying 2·3 per cent. of the total calories consumed by all the factories.

The first official forecast of the British India sugar cane production for 1927-28 states that the total area planted with cane this year is estimated at 2,893,000 acres, as against 2,755,000 acres at the corresponding date last year (end of August), or an increase of 5 per cent.

Sugar companies within the zone of Portuguese East Africa have lately received a fillip from the decision of the Lisbon Government to increase the duties on all sugar entering Portugal but to grant to the whole of the sugar imported from Portuguese colonies a rebate of 50 per cent.

Arrangements are being made for the establishment in the Fraser Valley, British Columbia, of a beet sugar industry, the promoters being an English Company with a capital of two million dollars. The estate will be worked, it is reported, by English and Scotch labour. The site of the factory is to be at New Westminster.

At the City of London College, commencing September, a course of lectures is to be given on the Sugar Trade, consisting of : Section I, Scientific Study of Sugar, by Mr. S. J. Duly, M.A. ; Section II, Economic Geography and Statistics of Sugar, by Mr. C. J. Robertson, M.A., B.Sc. ; and Section III, Marketing of Sugar, by Mr. Wm. O'Toole, the Secretary to the Sugar Association of London, and of the United Terminal Sugar Market Association.

At the Chemical Industries Exposition, recently held at New York City, Gilchrist & Company gave some very clear demonstrations of the workings of equipment involving new principles. Among these are showings of the combustion results secured from the utilization of reflected heat in the Gilchrist furnace, of the exceedingly high settling efficiency developed by the parallel flow settler, which involves an entirely new principle, and of the purification results achieved by both mechanical and chemical processes in the Gilchrist Coagulator. The results secured by the use of these methods have developed interest among sugar producers.

At the 50th annual meeting of the Distillers Co., Ltd., held recently in London, the Chairman, Mr. Wm. H. Ross, made allusion to the experiments the Company were conducting to provide an alternative motor fuel. The improved position of petrol supply, and the uncertainty of finding a raw material for producing alcohol in this country at a low enough price, had proved to be difficult. But, in conjunction with local sugar planters and other Australian interests, and supported by the State Government, and by the Commonwealth Parliament, a moderate sized distillery has been erected in Northern Queensland, where raw material can be obtained in considerable quantities at the minimum of cost.

At the recent Congress of the South African Sugar Technologists' Association,[2] W. V. Blewett discussed the conservation of valuable fertilizing elements in tops and trash, concluding that : General experience would lead one to recommend that trash near a mill should be collected, mixed with bagasse ash (or failing that a little lime) press-cake, and any waste liquors, etc., from the mill, water added, and the whole allowed to rot, stable drainage being added where possible. A very valuable compost would be thus formed, which, when well rotted, is the ideal material to return to the soil. If heavy dressings are used per acre (say 15 to 20 tons) they should be applied and ploughed in a couple of months before planting, as nitrification is reduced or even stopped for some time after the application. At greater distances from the mill, artificial methods of rotting the trash should be tried.

[1] *Archief*, 1927, 35, No. 21, 535-548.
[2] *S.A. Sugar J.*, May, 1927,

Brevities.

Last year Cuba exported 77,307 short tons of refined sugar, a marked increase over the figure for the previous year. It is believed that in some quarters it may be possible gradually to increase this, there being no question of the practicability of making fine white granulated in a tropical climate, given the necessary inducement.

The Carbo-Union of Germany, in which the I. G. Farbenindustrie A.-G. and the Metallbank concern possess controlling interests, has arrived at an agreement with the French Société de Charbons Actifs Urbains, whereby there will be complete reciprocity of patents between the two concerns in the domain of activated and absorbent carbons.

Sulphate of ammonia was used in Java last year in the sugar industry to the amount of 1,502,541 piculs (92,280 long tons), or on the average at the rate of 5·94 piculs per bouw (or 463 lbs. per acre). Superphosphate (single and double) amounted to 5020 tons; oil cake (*boenqkil*) 2533; stable manure, about 1267 tons; molasses, about 50,000 tons; filter-press cake, 7934 tons; boiler furnace ash, about 1891 tons.

At a recent meeting of the Association of the German Sugar Industry the following figures were given for the 1925-26 and 1926-27 seasons respectively: acreage, 913,900 and 904,020; yield of roots per acre, 10 tons 10 cwt. and 11 tons 9½ cwt.; sugar content of the beets, 15·48 and 15·23 per cent.; total production of sugar, 1,580,576, and 1,607,000 tons; consumption of sugar, 1,406,716 and 1,453,171 (estimated).

In Java very promising results have been obtained with the new cane POJ 2878, which is being planted heavily for next year's crop, some estates having decided to grow it exclusively. It gives 175-185 piculs per bouw as an average.[2] On the factory side, however, as the cane is heavy and thick-rinded, there is less enthusiasm, and in some cases the present milling equipment will have to be modified to deal with the crop.

A U.S. consular report states that the alcohol distillery installed early in 1926 in Mauritius is working satisfactorily. It has a capacity of 2642 gallons per day, at a production cost of about $0·047 per gallon. With low cost molasses available, it would appear that the total production cost would not exceed eight or nine cents per gallon, making it possible to sell alcohol locally for fuel purposes in competition with gasoline at about 37 cents per gallon.

"It is strongly urged that all factories should provide themselves with means of accurately weighing materials which are involved in the accountancy of the sugar, especially the juice and final molasses. The measure of liquids by volume on a large scale leads to unavoidable inaccuracies which are apt to vitiate the whole of the laboratory results; and it is considered from the point of view of efficiency of the factory that these liquids should be weighed as the cane entering and sugar leaving the process."[3]

"Nitro-chalk," a new fertilizer, which will shortly be placed on the English market, will consist simply of ammonium nitrate and dried carbonate of lime.[1] Hitherto, the valuable fertilizer ammonium nitrate has not been generally utilized as it should be by the farmer on account of certain properties it possesses which render it unsuitable for him to handle. Now it will be available in a dry form having about 10 per cent. of nitrogen at a price equivalent to that of ammonium sulphate, based on the unit of nitrogen content.

In an article[4] discussing the drying of beet tops, as compared with its silage, it is mentioned that the cost of a small plant having a daily capacity of 525 dz. (52·5 metric tons) corresponding to 87·5 dz. (8·75 tons) in 24 hours of dried material, would be 52,000 marks (say £2600) for material at the site, and another 28,000 (£1400) for erection, masonry, etc., making a total of 80,000 (£4000); from this it is calculated that the daily nett profit allowing for all possible expenses, and selling at 110 marks would be about 30 marks, or 18,054 marks (£903) in 60 days campaign. Similar calculations are given for medium and large plants.

[1] J. VAN HARREVELD in *Archief*, Medel., 1927, No. 10, 513-542.
[2] 6 to 6·5 long tons per acre.
[3] Proceedings of the 4th Annual Congress of the South African Sugar Association in a paper dealing with the "Standardization of Chemical Control."
[4] Dr. KEMPKEN in *Centr. Zuckerind.*, 1927, 35, No. 28, 809-810.

Review of Current Technical Literature.[1]

THE MISLEADING "UNDETERMINED LOSS" FIGURE: A REPLY TO H. G. HILL. W. J. Williams. *Facts about Sugar*, 1927, 22, *No.* 16, 389.

In a recent article Mr. H. G. HILL drew attention to the low undetermined losses reported by many of the factories in Cuba,[2] many of them returning figures less than 0·100 per cent. of the cane; and he concluded that 80 per cent. of those reporting to a central organization (presumably the Cuba Sugar Club) have manipulated their sucrose balances. The following reply is now made to these allegations:

"A chemist who puts out a report showing an exceptionally low undetermined loss or an undetermined gain knows that he invites criticism; but these are no grounds for assuming that he has manipulated the sucrose balance, as there are several factors which directly influence this figure. The undetermined loss, being found by difference, has to bear any errors in the weight of juice and its analysis, and errors in the determination of the amounts of sugar leaving the house in sugar bagged, molasses, and press cake. On run reports, it is influenced by the estimation of the stock in process. If this is overestimated on one run, the undetermined will be excessively high on the next run, and vice versa. The latter may even result in an undetermined gain. But the factors most likely to influence it, in so far as errors of determination are the weights of juice and final molasses. There are still many factories which measure the juice in tanks and estimate the weight after making a deduction for entrained air. The best to be said for this method is that the results are comparative for this particular factory, and if the undetermined losses depart from a theoretical figure the chemist should not be accused of manipulation; nor is he justified in changing any of his standards of measurement, as this would influence the mill and boiling house results, and to obtain comparative figures the standards of measurements must be the same. In a greater number of factories the final molasses is estimated by measurement in a large rank; and the writer has seen instances where the chemist had to estimate the weight of final molasses in a 500,000 gallon tank with the foam just beginnning to break over the top. Anyone who can accurately determine the weight of final molasses under these conditions deserves to rank with the prophets; but he must estimate as best he can, making allowance for the amount of foam. and calculate the gallons of molasses per ton of cane, per bag of sugar. All his previous experience may not apply to the molasses from this particular factory, and the result is that the figures for loss in molasses are either too high or too low. with a corresponding difference in the undetermined. There is no way for him to check his figures until the molasses is shipped away during the dead season, and the only course permissible is to go ahead and put down his figures as they come. The managements of the factories are not so much interested in the accurate estimation of final molasses as Mr. HILL infers. They always check the gallons reported by the chemist with the gallons shipped during the dead season, and if accurate figures were desired there could be more molasses scales and less estimation in storage tanks. Although Dr. SPENCER made the statement that the greater part of the reducing sugars in final molasses was levulose, one hesitates to say that he intended this to be applied so strictly and generally as Mr. HILL has presumed; it is far better to regard final molasses as varying greatly in optically-active substances in the different factories, and its complete chemical composition is a fit subject for research. To illustrate the danger of generalizing, the accompanying table has been prepared from a recent report of the Cuba Sugar Club. For convenience the depression of the rotatory power of sucrose present has been assumed as being due to the reducing sugars and has been calculated to the effect of 10 per cent. reducing sugars in degrees Ventzke. It will be seen that this figure varies from 0·89 to 4·56 and shows that the composition of the optically-active-substances other than sucrose is decidedly different in the final molasses produced by these factories.

Instead of setting a minimum for the unknown losses and judging the accuracy of a chemist by this figure it is far safer to judge each report according to the con-

[2] *I.S.J.*, 1927, 499. See also 1926, 382; 1927, 445.

ditions at that particular factory. We should remember that there may have been difficulty in obtaining the weights of juice and molasses; that the composition of reducing sugars or other optically-active bodies is subject to considerable variation, and we should also give credit for very careful factory work. The writer believes

Direct polarization	Sucrose by Clerget	Reducing sugars	Depression of rotation due to reducing sugars	Depression of rotation calculated to 10 per cent. reducing sugars
29·04	31·15	23·73	2·11	0·89
31·69	40·17	21·14	8·48	4·01
30·03	36·47	21·06	6·43	3·05
26·40	35·08	19·08	8·68	4·55
28·42	36·91	19·37	8·49	4·38
26·46	32·89	18·57	6·43	3·46
28·62	35·64	19·54	7·02	3·59
28·38	34·08	19·67	5·70	2·90
28·23	35·16	24·00	6·93	2·89

that 80 per cent. of the chemists in Cuba are as careful and honest as in any other country; that they are doing their best for the industry under their control and putting down the results exactly as they find them. The figures cited by Mr. Hill are undoubtedly correct and entirely possible; but there is no reason to assume that they apply with equal force everywhere and the writer knows of several instances where an undetermined loss of 0·200 or higher has led to the discovery of a real loss of sugar."

Composition and Feeding Value of Sugar Beet Tops. H. E. Woodman. *Journal of the Ministry of Agriculture*, 1927, **34**, *No.* 5, 563-566.

During the past year, there has been carried out at Cambridge an investigation into the question of the composition and nutritive value of sugar beet tops. Digestion experiments were conducted on sheep in which the daily ration was composed of 4000 grms. of sugar beet tops and 600 grms. of chaffed meadow hay of known digestibility, together with a few grms. of precipitated chalk. The tops, before being given to the animals, were allowed to wilt on the stone floor of a cool room for periods varying from three to six days; under such conditions, it was possible to leave the tops for over a month without decay setting in, excepting traces on the cut surfaces of the roots. Indeed, after 14 days' waiting, it was noted that the material had acquired a pleasant odour not unlike that of good hay. The sheep consumed the mixed ration of sugar beet tops and meadow hay with evident relish, displaying marked fondness for the tops. Such small food residues as were left in the experiment consisted entirely of hay. That stock are appreciative of sugar beet tops is not, however, demonstrated merely by the observations in this single trial. It is also borne out by experience on a much larger scale on the University Farm, where animals are annually permitted access to these sugar beet residues; and it is further confirmed by the unanimous opinion of all those farmers with whom the writer has had the opportunity of discussing the matter. This is an encouraging fact to keep in mind, then, that no difficulty of any kind need be expected in inducing farm animals to consume the crop of sugar beet tops. Regarding the composition of the tops the percentage of water usually amounts to 83 to 85 per cent., the wettest being those grown on fen soils, in which case, the moisture content may be as high as 88 per cent. In other words, such fen-grown tops may contain as much water as milk or mangolds. The percentage of carbohydrates is naturally dependent on the ratio of crown to leaf, which was fairly high, the leaves being somewhat stunted in growth, whereas the roots were of medium size. It was found that sugar constituted as much as 4·4 per cent. of the *moist* tops. Since the percentage of dry matter in the tops after wilting was 21·7 per cent., it follows that roughly one-fifth of the total dry substance in the sample consisted of sugar. The dry matter of sugar beet leaves contains about 26 per cent. of protein and only about 10 per cent. of fibre, so they may, therefore, be looked on as possessing the characteristics of an

immature green fodder like young pasture grass. The percentage of protein in the tops will be governed by the value of the ratio of crown to leaf, and will be high when the percentage of carbohydrate is low, and low when carbohydrate is present in large amount. Values were obtained for the protein content ranging from 9 to 19 per cent. of the dry matter. Beet tops are very rich in inorganic constituents and the amount may be augmented very considerably if care is not exercised in the field to prevent unnecessary contamination with soil. The various facts cited above are brought together in the following table, which records the composition of the sugar beet tops used in the digestion trial :—

	Dry matter basis Per cent.		Wet tops (83·8% moisture) Per cent.
Protein	12·55	....	2·03
Oil	2·76	....	0·45
Carbohydrate	53·61	....	8·68
Fibre	9·92	....	1·61
Ash	21·16	....	3·43

Results of digestion trials demonstrated that sugar beet tops constitute a highly digestible food. No less than 79 per cent. of the organic matter in the tops was utilized by sheep. The carbohydrate constituent which included the sugar in the crowns was especially well digested, the digested co-efficient attaining to the very satisfactory value of 83 per cent. Even the fibre in the tops was well utilized, the sheep being able to digest more than 70 per cent. of this constituent. It was shown that 100 lb. of the dry substance in sugar beet tops contained 61·8 lb. of digestible organic matter, equivalent to about 53 lb. starch, and including 8·9 lb. of digestible protein, 1·7 lb. of digestible oil, 44·2 lb. of digestible carbohydrate and 7 lb. of digestible fibre.

PRODUCTION OF GLYCERIN FROM MOLASSES. **Anon.** *Manchester Guardian (Commercial Edition)*; *through Chemical Trade Journal*, 1927, **81**, *No.* 2105, 327.

Production of glycerin from molasses mash, as a by-product in alcohol manufacture, suggested many years ago, has successfully materialized on a large scale. During the war the largest makers of alcohol in the United States built a plant at a cost of £30,000 for the recovery of glycerin from alcohol waste, but they could not at that time make a success of it. It has now been announced that the Eastern Alcohol Corporation, which is owned jointly by the du Pont de Nemours firm and the National Distillers' Products Corporation, have developed a new process for the recovery of glycerin present in fermented molasses mash, under United States patents No. 1,626,986, applied for in June, 1922, by S. K. VARNES, and No. 1,627,040, applied for at the same time by JAS. W. LAURIE. Both of these patents have been assigned to the du Pont Co. (issued May 3rd, 1927) with the intention of rendering the Company independent of the soap manufacturers for glycerin supplies required in explosives manufacture. Fermented molasses mash contains about 3 per cent. of glycerin and 6 per cent. of alcohol, and after the alcohol has been distilled off and the remaining liquor concentrated, the glycerin content is about 15 to 18 per cent. Its recovery and separation are, however, difficult on the technical scale, ordinary distillation methods being largely ienffective. But in VARNES' patent, the concentrated liquor, containing up to 18 per cent. of glycerin, is sprayed into a chamber or still under such conditions of temperature and pressure that a portion of the water and glycerin is vapourized into fine mist, and by introducing into the chamber a hot gaseous chemically inert carrier, such as superheated steam or carbon dioxide, additional heat is supplied to the mist which then passes from the chamber, the glycerin being recovered in suitable condensers. The Eastern Alcohol Corporation plant is said to have a capacity of 10,000,000 gallons a year, involving the use of some 30,000,000 gallons of fermented molasses. From this the theoretical yield of glycerin would be over 4,000,000 gallons. Since VARNES claims a 92·98 per cent. glycerin recovery, the actual amount of glycerin would be in the neighbourhood of 40,000,000 lb., taking maximum figures as the basis. Glycerin production in the United States is about 50,000 tons, and in the United Kingdom about 40,000 tons.

The cost of glycerin production from molasses mash is reported to be about 12 to 15 cents a lb.; and 12 cents a lb. is about the lowest figure at which the soap manufacturers can recover glycerin. It is understood that du Ponts will have a surplus above their own needs, and if other alcohol distillers erect glycerin recovery plants there will be large supplies available for the open market.

TROUBLE WITH LEUCONOSTOC AND ACID-FORMING BACTERIA IN THE MILLING PLANT. **Ch. H. Nielsen.** *Archief (Verslagen Afl., No.* 4), 1927, 133-142.

At one of the recent Conferences of sugar men in Java, an account was given of experiences with contamination by micro-organisms at the mills. In all factories there was found to be contamination, which spread more extensively and rapidly than in previous years, and in some places conditions were such that, only a few hours after washing and disinfecting the milling plant, a layer of slime appeared everywhere the juice came into contact, a sharp unpleasant sour smell being moreover evident. Ordinary means for combating this nuisance failed absolutely. At the Djatiroto I factory, for example, infection was so bad in the raw juice tanks that a special shift of coolies had to be put on to fish out the lumps of dextran, a great volume of it being removed daily. But at length the trouble was coped with by placing steam injectors in the tanks in positions such that no dead corners were left. Sometimes great sugar losses occurred by the acidifying of the juice as the result of the micro-organisms, and it was not possible to keep these within ordinary limits except by taking special measures. One was to shorten as far as possible the path of the raw juice from mill to storage tanks, cutting out the sand catchers; another to use a disinfectant wash (though the effect of this soon disappeared); while another was to fix a jet in the cold juice gutter in order to steam it out periodically. According to the Experiment Station the acidifying micro-organisms concerned were butyric and lactic acid bacteria, some cocci, and some few yeast cells,; the former appeared to be the most active, not being destroyed at temperatures below 80 C. As the result of the acidifying of the juice, black deposits were removed from the piping, these consisting largely of iron. It is suggested that this increase in the activity of micro-organisms at the mills may possibly have some connexion with the new cane varieties that have recently been ground, though this point requires certain further investigation for verification.

EFFECT OF THE *pH* ON THE ADSORPTION OF NON-SUGARS BY DECOLORIZING CARBONS. **S. M. Hauge and J. J. Willaman.**[1] *Industrial and Engineering Chemistry*, 1927, **19**, *No.* 8, 943-953.

One of the most important factors in determining the adsorbability of substances by carbons is the hydrogen-ion concentration (*pH*) of the solutions. The importance of determining the reaction of the solution has been overlooked by most investigators, and for this reason most of the earlier tests on the adsorptive power of carbons are of little value for a comparative study of the decolorizing efficiency of various carbons. Adsorption by chars of electronegative, electropositive, and amphoteric substances has been shown in this paper to be greatly affected by the reaction of the medium. This seemed to be a more important factor in most cases than the nature of the carbon. Thus the order of relative values of the various carbons in caramel solutions at a *pH* of 7 would be: Norit, Darco, Superfiltchar, Carbrox, apple char, boneblack, blood charcoal, and sugar char; while if they were tested at *pH* 4 quite different results would be obtained, with the order of efficiency changed to: boneblack, Norit, apple char, Carbrox, Superfiltchar, blood charcoal, and sugar char. It is apparent that methods in which the solutions are adjusted to one *pH* value do not disclose the possibilities of the carbons for adsorption at other values. Similar relations could be pointed out for the other substances used. On the basis of these relationships, an explanation is apparent for the results secured by different investigators on which exaggerated claims have been made for various carbons, such as being twenty, thirty, etc., times as efficient as others. These differences may have been due not so much to the properties of the carbons as to the reactions of

[1] Of the University of Minnesota, St. Paul, Minn., U.S.A.

the media. The explanation offered for influence of *pH* on adsorption is based principally on the electrical theory of adsorption. Acids and alkalies are known to affect the charge on substances. Therefore, with variation in *pH* of the solutions it would be expected that changes in the magnitude of the charge on colloidal particles and on the carbons take place which either favour or inhibit adsorption of substances. The cataphoretic measurements on the caramel solutions at various *pH*'s show that the velocity of migration increases with increase of *pH*. Since caramel is flocculated by acids and peptized by alkalies, the increased acidity of the solution may act in two ways—to decrease the charge on the individual particle and to increase the size of the particles. The results of the present studies indicate in general that the efficiency of adsorption by carbons is dependent largely on the difference in electrical potential between the carbon and the adsorbate. Thus, alkalinity favours the adsorption of positively charged substances, such as methylene blue; acidity favours the negatively charged, such as caramel; and amphoteric substances, such as proteins, are best adsorbed in the region of *pH* 3 to 6, with decided minima at extremes of acidity and alkalinity. The adsorption of a non-electrolytic substance such as dextrose is not effected by *pH*. The results of the experiments reported in this paper show that the electrical nature of the substances to be adsorbed is a deciding factor in determining the degree of adsorption under definite conditions of *pH*. A careful choice of conditions would make it possible to adsorb one type of compound and leave an oppositely charged substance largely in solution and thus increase the preferential adsorption of the carbon. It is recognized that in all industries the extreme range of *pH* necessary to adsorb efficiently all types of compounds would not be applicable. Therefore, the use of fuller's earth, kaolin, and other substances which possess characteristics in electrical charges different from carbon, may under certain conditions be used more effectively than carbon for the adsorption of certain types of substances. The value of carbons for industrial purposes might be greatly increased if a carbon were produced which would be active at the permissible *pH* for the substance involved. Although carbon is not electrically charged by itself—that is, it does not possess active groups, such as COOH, to give it a charge, but acquires electrical properties due to the medium in which it is in contact—the electrical properties can be greatly modified by processes of activation. This is proved conclusively by the work of OGAWA,[1] who showed that the isoelectric point of carbon was shifted during the process of activation by heat alone. It may be possible to produce a carbon which would be positive at all *pH*'s. This would be a great addition to the carbons now available and greatly simplify the problems of decolorization, since most coloured impurities met with in the industries dealing with biological materials are negatively charged.

SUGAR, ETC., BY THE ALPHA-NAPHTHOL TEST. **Jan Schlemmer.** *Zeitsch. Zuckerind. Czecho.*, 1927, **51**, *No.* 37, 422-427. Alpha-naphthol provides a very delicate test for traces of sucrose in solution,[2] but if before its application the sugar solution be heated in a boiling water-bath for 10-12 mins., with lime-milk (10 per cent.) then it is found that sucrose, raffinose and reversion products (such as are found in commercial starch glucose) still give a positive reaction, whereas dextrose, levulose, lactose, maltose, starch, dextrin, inulin, and glycogen no longer react.—GERMAN BEETS CONTAINING 3 PER CENT. OF MARC. **Emile Saillard.** *Journal des Fabricants de Sucre de France*, 1927, **68**, *No.* 25. SPENGLER and BRENDEL recently published an article[1] in which they referred to German beets which contained 16 per cent. of sucrose and only 3 per cent. of marc. But, since German factories contract to return to their farmers 50 kg. of pressed pulp containing 10 per cent. of dry matter per 100 kg. of roots delivered, it is difficult to see how this is possible. Obviously the German chemists' marc determinations were wrong, and 5 per cent. should have been indicated, this being the usual figure for a sugar content of 16 per cent.—NEW METHOD OF DETERMINING DEXTROSE (GLUCOSE) VOLUMETRICALLY. **Alexis Voorhies and A. M. Alvarado.** *Industrial and Engineering Chemistry*, 1927, **19**, *No.* 7, 848-849. It was hoped that by using an oxidizing agent, as iodine in alkaline

[1] *Biochem. Zeitsch.*, 1925, **162**, 275. [2] *I.S.J.*, 1916, 139, 436; 1917, 28. [1] *I.S.J.*, 1927, 225.

solution, and operating at room temperature, the oxidation would proceed only to the stage at which gluconic acid is formed. Experiments are described showing, however, that even at temperatures up to 90° C. oxidation to the gluconic acid stage is incomplete.—ORIGIN AND NATURE OF MOLASSES. **Jar. Dedek.** *Chemické Listy*; through *Zeitsch. Ver. deut. Zuckerind.*, 1927, 495-561. Cause of the uncrystallizability of beet molasses is to be sought neither in its colloid substances nor in its viscosity, it being a stable system, having quite a definite form of solubility area (i.e., in a 3-component phase diagram). From the results of crystallization experiments with solutions of sucrose and salts, as well as from the established data relating to molasses, it was deduced that an area of this shape was possible, these solutions in fact possessing it. It is caused by the mutual solubility, and by the mutual effect on the solubility, of sugar and salts without it being necessary to assume the existence of compounds in the classical meaning of the word. Both artificial solutions and technical molasses cease crystallizing at an equimolecular ratio of sucrose to sodium plus potassium, which ratio is the only reliable sign of a completely exhausted molasses. Cane molasses behaves very similarly to beet, being however, less well exhausted.—FERMENTATION OF CANE MOLASSES. **E. Kayser.** *Annales des Falsifications*, 1927, **20**, 326-328. By adding to fermenting molasses some magnesium phosphate, or yeast which has undergone autolysis, the amount of higher alcohols is increased. If an aerobic yeast is used, the amount of the esters obtained is considerably increased as well.—DETERMINATION OF SULPHUR DIOXIDE. **R. Mestre.** *Bull. Assoc. Chim. Sucr.*, 1927, **44**, 317-319. According to this writer, one cannot expect reliable results with the distillation method, owing to the high content in sugars and the relatively low amount of sulphur dioxide. The iodometric method should be used, but this is inaccurate in alkaline medium, as addition products form between sulphur dioxide and all constituents of aldehydic or ketonic function. But results closer to the truth are found by titrating with iodine in acid or neutral solution.—DETERMINATION OF SUGAR IN CARBONATION SCUMS. **Ph. Orth.** *Bull. Assoc. Chim. Sucr.*, 1927, **44**, 334-336. Another contribution to this discussion.[1] This chemist produces figures showing clearly that between OST's method (in which the scums are mixed with ammonium nitrate and some water, neutralized with acetic acid, defecated with lead, and made up to volume), and the Künz method (in which the scums are entirely dissolved in acetic acid) there may be a difference as much as 1·38 per cent, the latter being the higher. It is believed that in the ordinary method some insoluble sugar compound ("carbonate sugar"), decomposable by acid is present. It is now found that prolonged contact with water will also render all the sugar soluble, so that afterwards it can be determined by the ordinary methods.—SURFACE TENSION MEASUREMENTS OF SUGAR SOLUTIONS. **P. Honig.** *Chemisch Weekblad*, 1926, **23**, 265-269. Contrary to the opinion of LINDFORS,[2] the author concludes that a reliable indication of the amount of colloids in sugar juices and syrups cannot be obtained from the variable values for the surface tension given by the DU NOUY's apparatus[3] and by TRAUBE's stalagmometer[4] (drop-weight method). There is no relation between the s.t. value and the colloidal impurities occurring in solution of raw sugars.[5]—DECOLORIZATION OF CLARIFIED JUICE BY DECOLORIZING CARBON. **A. Linsbauer.** *Zeitsch. Zuckerind. Czecho.*, 1927, **51**, No. 41, 483-490. As the presence of sugar decreases the effect of decolorizing carbon, it is more economical to apply it to the thin-juices rather than to the syrups; only 0·03 to 0·04 per cent. of "Carboraffin" on the dry substances is required for juice, whereas double this amount is necessary for syrup.—PELIGOT'S SACCHARAN. **Karl Vnuk.** *Zeitsch. Zuckerind. Czecho.*, 1927, **51**, 460-466, 467-477. Glucosaccharin (the lactone of saccharinic acid) was prepared and examined. It was observed that, in consequence of its high dextro-rotation, saccharan disturbs the double polarization (Clerget) method of determining sugar, and its effect is not eliminated even in the ANDRLIK-STANEK modification (in which the direct polarization is taken in the presence of the same amount of hydrochloric acid as is present in the inversion reading).

J. P. O.

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[1] *I.S.J.*, 1921, 292; 1925, 335. [2] *I.S.J.*, 1925, 653. [3] *J. Gen. Physiol.*, 1919, 1, 521. [4] *I.S J.*, 1926, 444.

[5] These conclusions should be compared with those arrived at by SAZAVSKY (see *I.S J.*, 1926, 618), who stated the limitations of the stalagmometer, and the factors that affect the s.t. determination generally.

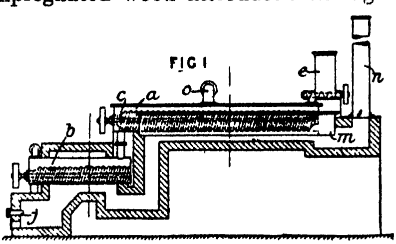
Review of Recent Patents.[1]

UNITED KINGDOM.

Production, Application, and Revivification of Activated (Decolorizing) Carbon. (*A*) **N. V. Algemeene Norit Mij. (General Norit Co., Ltd.)** of Amsterdam, Holland. 273,761. July 2nd, 1927; convention date, July 3rd, 1926. (*B*) **K. S. C. Bone, and Wilson Bros. Bobbin Co.**, of Garston, Liverpool. 274,538. March 19th, 1926.

(*A*) In the manufacture of activated carbon from carbonaceous materials by treatment with heat and an activating gas such as superheated steam, carbon dioxide, air, chlorine, sulphur dioxide, combustion or generator gases, etc., vertical or substantially vertical retorts are used, of elongated cross-section with the major dimension at least double the minor dimension, and at least 50 cm., e.g., several metres. The cross-section may be rectangular with combustion flues and openings for the activating gas and for the heating gas, if it is used directly, at the longer sides. Large pieces of raw material, e.g., peat, may be treated in admixture with a large amount of fine material, e.g. peat dust, sawdust, etc., and the time of treatment may be shortened so as to activate fully only the finer material and the outside of the coarser material, the finer material being then separated, e.g., by screening. The coarser material, which may next be broken or ground and have fresh raw material added to it, is then further activated. In treating peat, it is first gradually heated up to 200-250°C., e.g., by gases already used for heating another zone, steam mainly being evolved and may be collected separately, superheated, and employed for activation. In the subsequent distillation stage a gas usable for heating is obtained, together with tarry products, ammonia, acetic acid and methyl alcohol which may be condensed. In the final activation stage employing superheated steam, water gas is produced and may be used for heating the retort, being passed directly through the distillation zone. The activated material may be cooled by introducing steam or other activating gas at the bottom of the retort, the steam being thereby superheated (Specifications 167,195 and 189,148[2] are referred to).

(*B*) In the production of active carbon, finely divided wood impregnated with calcium acetate is continuously fed as a layer through a retort and is gradually and uniformly raised to at least 1000°C. in its passage therethrough, the vapours which are released however being drawn off at a low temperature, preferably not exceeding 450°C., whereby creosote oils instead of tar are obtained. A single retort may be used; a bath of lead being provided at the end from which the vapours are withdrawn, but in the preferred method two retorts in series are employed. The impregnated wood introduced through a hopper *e* is conveyed through the first retort *a* by means of a pair of intermeshing members *c*, *d*, and is then similarly passed through the second retort *b*, below which is placed a fuel burner *j*. Combustion products from the burner, after heating the retort *b* pass around a jacket *m* which surrounds the retort *a* and contains molten lead and finally escape to the stack *n*. Acetone, methylethylketone, higher ketones, methyl alcohol, acetic acid and creosote oils are withdrawn through one or more exit pipes *o*. The active carbon removed from the retort *b* with avoidance of oxidation is extracted with acetic or hydrochloric acid to remove ash and calcium carbonate. The pyroligneous acid produced may be utilized to prepare pyrolignite of calcium for reuse.



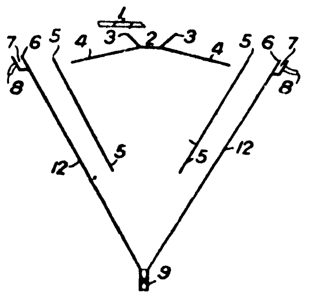
[1] Copies of specifications of patents with their drawings can be obtained on application to the following—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price 1s each). Abstracts of United Kingdom patents marked in our Review with a star (*) are reproduced from the *Illustrated Official Journal* (*Patents*), with the permission of the Controller of H.M. Stationery Office, London. Sometimes only the drawing or drawings are so reproduced. *United States:* Commissioner of Patents, Washington, D.C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille, du Temple, Paris. *Germany:* Patentamt, Berlin, Germany.

[2] *I.S.J.*, 1921, 648; 1923, 166.

Patents.

SEPARATING SOLID PARTICLES FROM LIQUIDS (FOR THE TREATMENT OF THE EFFLUENT FROM BEET FACTORIES). **R. J. Marx,** of London. 272,130. February 3rd, 1927.

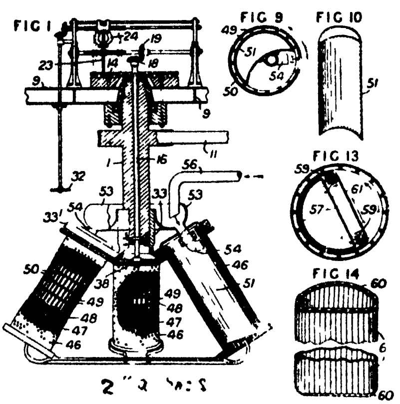
Separation of solid particles from liquids by settlement is promoted by causing the liquid to fall in a thin film on to a hard surface, so as to detach air bubbles from the particles, prior to the entry of the liquid into the settling tank. The process is applicable generally; and its application to the treatment of effluent from beet-sugar works and other waste liquid is mentioned. It is explained that solid particles of small dimensions contained in liquids, especially when they float or are suspended therein, are generally surrounded in or encased by numerous minute air bubbles. These bubbles become so much part-and-parcel of the particles to which they adhere as in effect to reduce their specific gravity so long as they adhere thereto. This state of things obtains in the case of effluents from various industries, such as beet sugar production. It may also happen with fresh water from rivers or other sources.



The adhesion of the air bubbles to the particles makes the removal of such particles difficult and sometimes impossible by the ordinary methods and the smaller the bubbles the greater the difficulty. This is particularly the case in handling washing waters from mines, white waters from paper mills and generally all effluents in which solids are contained or suspended in a finely divided state. It has been proposed to promote the separation of fibrous and other matter from liquid in a settling tank by previously subjecting the liquid to impact as the result of a fall under gravity, with a view to causing the detachment of air bubbles from the solid particles. This invention however consists essentially in mechanically removing the air bubbles from the solid particles to which they adhere, by causing the liquid to fall from a height in the form of a thin film tending to divide up into separate drops on to a hard surface prior to its entry into a container in which the solid matter spread over such surface by the division of the drops is collected, by settling down at its own proper specific gravity while the liquid flows out by convenient outlets. The invention can be carried into effect in various types of apparatus which serve to separate liquids from solid particles contained therein as hereinbefore mentioned. It is of special advantage, not only in the treatment of effluents for the recovery of solids having an industrial value, but also for the clarification of the liquid either to permit its re-use or to render it more fit for discharge into rivers by the elimination of obnoxious ingredients. The invention is of special advantage when dealing with effluents subject to chemical changes in a relatively short space of time, such as the wash and process water from beet sugar factories. When such effluents are passed through apparatus adapted to enable this invention to be employed, the debris of the sugar beets, or other substances, can be separated from the liquid in which they are contained before they undergo organic changes by chemical reaction. Referring to the drawing, liquid is supplied by a pipe 1 to a vessel 2, passes as a thin film over the edge 3 and falls on to a surface 4. It passes downward in the centre of the tank 12 and rises outside an inner wall 5 to overflow, as a film, the edge 6 into a trough 7 having discharge pipes 8. A valve 9 is provided for the continuous discharge of the settled solid matter. Generally speaking, the capacity must be increased in proportion to the time taken by the solids to settle down and to the minuteness of the particles held in suspension in the liquid. By way of example, the container 10, should be of such a size as to be adapted to hold all the liquid which enters through the inlet pipe during the course of one hour or even longer, according to the nature and size of the particles held in suspension. In treating other liquids the time factor necessarily depends upon the nature of the suspensions in the liquid as well as on their size, and no more definite general rule can be stated. Effluents, in which the fibres, solids or colloids held in suspension are not deposited

in an open or closed container of ordinary type during several days with the container perfectly at rest, will deposit such fibres or solids together with the colloids (or a part thereof according to their nature) by means of this invention during a transit time of not more than three hours, while at the same time the liquid is clarified to a great extent.

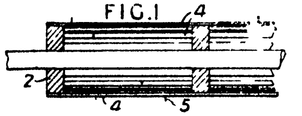
Continuously Operating Centrifugal for Separating Sugar from Molasses, etc. **Marcos L. Sansaricq**, of Havana, Cuba. 272,047. June 21st, 1926. This invention relates to improvements in continuously operating centrifugal machines for separating solid from liquid substances, and relates more particularly to machines for separating molasses from sugar of the kind in which the material to be treated is introduced into a plurality of nets or baskets which are continuously otated about their own individual axes. In machines of this kind as previously proposed, the baskets were rotated about a common axis by means of a main shaft to which they were connected, and were rotated about their own axes, either by means of adjustable friction gearing driven by a pulley on the main shaft, or by means of a pinion, mounted on a sleeve surrounding the main shaft, meshing with a ring of spur teeth arranged around the circumference of each of said nets or baskets. But in the present invention the nets or baskets are suspended from a hollow shaft rotatably mounted in a supporting frame, said nets or baskets each being engaged by a gear carried by a second shaft mounted within said hollow shaft, and means carried by said supporting frame for effecting rotation of said second shaft independently of the speed and/or direction of rotation of the main shaft. The invention also consists in an improved centrifugal machine of the kind referred to, characterized in that the nets or baskets each comprise a plurality of filtering bodies, and means are provided therein which cause the continuous centrifugation of the material to be treated as it descends through centrifugal action towards the outlet of said nets or baskets as stated. A number of strainer separators are arranged about the axis of a centrifugal machine and each is rotated about its own axis as well as the machine axis, and the apparatus can be used for the separation of sugar from molasses or any other similar purpose. The strainer drums are supported by arms 33^1 on a sleeve 33 at the bottom end of the hollow shaft 1; the upper end of the shaft is supported on ball bearings carried on the beam 9. A spindle 16 passes through the hollow shaft 1, and carries a bevel wheel 38 which engages toothed wheels on the strainer drums. The spindle 16 is operated from a disc 14 rotating with the shaft 1 by means of a friction wheel 23 and bevel gearing 19, 18. The rate of rotation relatively to that of the shaft 1 can be varied by moving the wheel 23 radially inwards or outwards over the disc 14 by means of the guide 24 operated by the handle 32. The shaft 1 is driven by the belt 11. The external wall of each strainer drum consists of a perforated metal plate 46 ; inside this is a body 47 of wide wire netting, a body 48 of fine wire gauze or filter-cloth, and then a cage consisting of bars 49 and rings 50. Each strainer contains a drum 51 part-cylindrical in form with closed ends ; it conforms closely to the cage 49, 50 and is supported by a radial arm from the central standard of the machine. An annular trough 53 is secured to the sleeve 33 and receives the material from the supply pipe 56. This material passes into the strainers through pipes 54 and the solid material remains encrusted in the grating 49, 50 at the same time travelling behind the drum 51 during part of each revolution and travelling down the drum during its treatment until it is discharged at the lower end. In a modification the retention drum 51 is replaced by a semi-cylinder 57, Fig. 13. Loose pinions 59 supported in brackets at



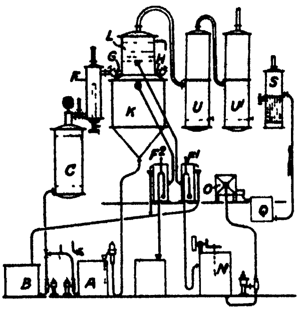
each end of the cylinder 57 support chains 60 carrying an endless belt with slots 61. The chains are geared with crowns on the strainers to keep the belt moving.

Improvements in Apparatus for the Cleaning of Sugar Beetroots. **F. Brochet,** of Paris, France. 270,835. February 22nd, 1926. Machines for cleaning beetroots and tubers comprise rotating cylinders each constructed of longitudinal bars 4 mounted on discs 2 and carrying a helical line of points 5 adapted to scrape and forward the roots placed in contact with them. A pair of cylinders of different sizes may be used, the cylinders lying side by side and rotating in the same direction. Alternative arrangements comprise (1) a duplicated and symmetrical form of the above arrangement, (2) three cylinders side by side, one of the outer rollers being larger than the others, (3) a single cylinder of large diameter which may if desired be conical, the roots being delivered on to the smaller or the larger end according to the nature of the soil from which they are taken. The line of points 5 in the last construction may be interrupted in the centre of the cylinder and replaced by a circularly arranged point to increase the duration of the cleaning action.—Fermentation of Cellulosic Materials. **H. Langwell, E. Ricard,** and **W. A. Burton.** 271,254. November 26th, 1925. In the fermentation of cellulose materials by thermophilic bacteria in a mash in which the hydrogen ion concentration is maintained within the limits 10^{-7} and 10^{-5} the nutrients supplied consist wholly or partly of waste liquors or residues from fermentation processes for the production of ethyl alcohol, butyl alcohol, acetone, butyric acid, lactic acid and the like, either before or after the removal of the useful products. Fermentation of Saccharine Solutions. **J. P. H. Jansen.** 271,336. November 10th, 1925. In fermenting sugar solutions to produce alcohol, salts forming hexose compounds, such as alkali phosphates, and hydrocyanic acid are added in small quantities with the yeast to the solutions.—Polarimeters. **E. Leitz,** of Wetzlar, Germany. 271,824. March 9th, 1927; convention date, May 31st, 1926. Polarimeters employing half-shadow devices are fitted with one or more glass plates in combination with the half-shadow devices. The inclination of these glass plates can be varied to compensate for the optical rotatory power of the substance under examination, and this inclination enables readings to be effected on a more open scale than if an analyser or quartz wedge were rotated. The plane of incidence of the glass plate makes an angle of 45° or 135° with the bisecting line of the half-shadow device. A quartz wedge may also be fitted, and is cut parallel to the optical axis, being arranged so that one plane of polarization in the wedge bisects the half-shadow angle of the half-shadow device.—Production of Levulose (Fructose). **Chemische Fabrik auf Actien, vorm. E. Schering,** of Berlin, Germany. 272,976. May 23rd, 1927; convention date, June 15th, 1926. An aqueous pulp of inulin is treated with a volatile organic acid such as formic acid, acetic acid, or carbonic acid. The syrup obtained may be treated with decolorizing charcoal and is concentrated to obtain the fructose direct. When carbonic acid is employed the process is carried on in autoclaves.—Scale Prevention. **E. Haasz,** of Budapest, Austria. 274,061. June 24th, 1927; convention date, July 6th, 1926. An alternating current, which may be one phase of a polyphase current, is passed through the wall of the boiler, evaporator, or like apparatus.—Sugar Extraction. **K. Komers and K. Cuker,** of Tavikovice, Moravia, Czecho-Slovakia. 274,131. July 11th, 1927; convention date, July 10th, 1926. A diffusion process for treating slices of beet, cane, etc. consists in the removal of the superficial juices in centrifuges, suction filters, presses, etc., wherein the material is treated to a gentle squeezing or suction without damaging the cell membrane, the material being then subjected to an oxidizing current of gas which dries the cells and concentrates their internal juices, thus raising the osmotic pressure and accelerating the diffusion process. A battery of diffusers can be employed with centrifuges, etc., for the preliminary treatment interposed between some of the diffusers.—Recovery of Glycerin from Distillery Slops (vinasse). **Soc. des Establissements Barbet,** of Paris. 274,519. July 19th, 1927; convention date, July 19th, 1926. Glycerin is extracted

FIG. 1



from vinasse liquors by adding petroleum or toluol, benzol, etc., to the concentrated liquor, superheating the mixture under a pressure of 6-8 kgs. and then releasing



the pressure so that the moisture evaporates and part of the glycerin is carried over with the petroleum. The product separates into two parts, one containing vesicular particles which is returned to the vinasse liquor for retreatment, while the other is rectified, purified with charcoal, filtered, and condensed in vacuo. The apparatus comprises a vat *A* from which the vinasse liquors are pumped to a tubular still *C* where they are mixed with petroleum from a tank *B*. The mixture passes to a heater *F* where it is heated under a pressure of 6-8 kgs. by steam. When the desired temperature is attained, needle valves *H* in a circular pipe *G* are opened and the mixture passes over into a vessel *K* where it evaporates owing to the reduction in pressure. The glycerin and petroleum vapours pass up through plates *L* sprayed with water thus condensing the glycerin which is removed to two Florentine receivers F^1, F^2 where any petroleum is separated and then passes after mixture with charcoal in a vat *N* to a filter-press *O* and receiver *Q* and vacuum concentrator *S*. Uncondensed vapours pass to the vinasse concentrator *U*, U^1, while the residue in the vessel *K* is returned to the vat *A*.—BOILING AND CURING SUGAR. **Raffinerie Tirlemontoise Soc. Anon.** of Tirlemont, Belgium. (*A*) 274,799; (*B*) 274,800. November 2nd, 1926; convention date, July 24th, 1926. (*A*) An increased yield of sugar crystals is obtained from massecuite by cooling it to a pasty or plastic condition, in which it is not normally adapted for centrifugal treatment, but then separating it into crystals and syrup in centrifuges operating at considerably greater centrifugal force than those previously employed. The water content of the massecuite may be reduced by evaporation, etc., at or subsequent to the cooling. (*B*) False grain is removed from syrup or molasses by treatment with very high centrifugal force in unperforated centrifuges. The false grain collects on the surface of the drum and is removed. The syrup is skimmed off from the centre of the drum. Air, carbon dioxide, or other gas in a finely divided state may first be mixed with the mass, the false grain being then collected in the froth formed during the treatment. The high centrifugal force may be obtained by altering the speed or the diameter of the drum, or both.—ADSORBENTS FOR SUGAR JUICES, SYRUPS, ETC. **A. Rosenheim,** of Charlottenburg, Berlin, Germany. 275,203. July 12th, 1927; convention date, July 30th, 1926. The basic content of natural or artificial zeolites, or of similar substances such as glauconite, tuffs, or natural glasses is wholly or partially extracted as by treatment with acids or acid salts, the resulting product being adapted for use as an adsorbent for decolorizing or deodorizing liquids, such as sugar solutions, etc. Before treatment the zeolitic material may be heated, say to 300-800°C., and additionally, the acid-acting constituent present in addition to silicic acid may be wholly or partially extracted. The material may, for instance, be treated at normal or raised temperature and with or without pressure or vacuum with one or more of the following:—hydrochloric, sulphuric, phosphoric, sulphurous, carbonic, formic, acetic, oxalic, lactic or butyric acids, ammonium salts, bisulphates, ferric chloride, sulphate, or acetate, ferrous sulphate, aluminium chloride or sulphate, alums. When the base-extracting means used, e.g., ferric chloride, is such as to introduce a new constituent into the zeolite, this latter may be extracted by further acid treatment. Before use, the adsorbent may be washed, with water or salt solution, e.g., of common salt, and be then dried.—EVAPORATOR. **W. Wiegand,** of Merseberg, Germany. 272,703. July 23rd, 1926. In evaporators, particularly suitable for dealing with thick liquids, the liquid is circulated by a centrifugal pump through a tubular heating-device into an evaporating-chamber through an opening the area of which may be controlled by a fixed or adjustable flap to prevent boiling in the heating-tubes or formation of scum. Steam for heating passes through a steam injector which draws part of the steam formed in the evaporator into the heating device

UNITED STATES.

Production, Application, and Revivification of Activated (Decolorizing) Carbon. (*A*) **George W. Wallace,** of San Francisco, Cal., U.S.A. 1,639,356. August 16th, 1927. (*B*) **George W. Wallace,** of San Francisco, Cal., U.S.A. 1,639,390. August 16th, 1927. (*C*) **George W. Wallace,** of San Francisco, Cal., U.S.A. 1,639,391. August 16th, 1927. (*D*) **George W. Wallace,** of San Francisco, Cal., U.S.A. 1,639,417. August 16th, 1927. (*E*) **John N. A. Sauer,** of Amsterdam, Holland. 1,641,053. August 30th, 1927. (*F*) **Paul Lueg, Julius Drucker, and Heinz Thienemann** (assignors to the **I. G. Farbenindustrie A.-G.**) of Frankfort-on-the-Main, Germany. 1,641,281. September 6th, 1927.

(*A*) Claim is made for the process of making activated carbon which comprises establishing and maintaining a relatively short moving pervious column of material to be carbonized with the smaller end of the front passage, the rear passage having a peripheral inlet and the front passage having an enlarged axial outlet. (*B*) In a carbonizing apparatus, is provided a short and wide, substantially horizontal reaction chamber in the form of a conduit, stoker means for supplying fresh material at one end and advancing the same therethrough as a charge filling the entire cross-section of said conduit, means for removing gases and vapours at the same end and localized heating means for impinging hot gases against a charge in the chamber at the other end, such localized heating means being adapted to permit the establishment and maintenance of a substantially stationary carbonizing zone at one point in said reaction chamber. (*C*) In the low temperature distillation and carbonization and gasification of solid fuel containing volatile matter, a process comprises establishing and maintaining a substantially horizontal moving column of material to be carbonized, impinging a flame of burning gases on one end of said column, passing said burning gases through the material in counter-current, maintaining the opposite end relatively cool, whereby an intermediate stationary zone of carbonization is established and maintained at a self-regulating temperature, and gasifying the hot materials coming from the end against which the flame gases are directed by passing a draft current through the materials to effect such gasification. (*D*) In the production of coke or smokeless fuel and by-products by carbonization, claim is made for the process establishing and maintaining a moving, substantially horizontal pervious column of fragmentary solid carbonizable material in a chamber of conduit form as a full area charge, one end of said column being formed by incoming relatively cool material, impinging a flame on the other end of said column and transmitting hot flame gases through said column in a direction counter to the passage of solid materials, whereby a stationary zone of carbonization is established and maintained. (*E*) A process of producing activated carbon from raw or carbonized carbonaceous material, by the aid of heat and of activating gas is described, in which the material to be activated is maintained in a state of agitation and flotation by a blast of gas, the activated product being drawn off by the discharged reaction gases. (*F*) A process for the production of active carbon comprises treating cellulosic carbonaceous material with sulphuric acid at temperatures above 300° C. and subsequently subjecting the material to steam activation.

Extraction of Pure Cellulose from Bagasse. **E. C. H. Valet.** 1,630,147. May 24th, 1927. Bagasse in small particles is extracted with 3·5 per cent. milk-of-lime, and heated under 1·5 atmospheric pressure with a mixture of 6 per cent. sodium hydroxide and 2-3 per cent. sodium sulphite for 4 to 6 hours, the cellulose obtained being cleaned by treatment with steam and bleached.—**Improved Beet Harvester.** **Gerrit Wandscheer,** of Sioux Center, Iowa, U.S.A. 1,636,883. July 26th, 1927. In a harvester, a vehicle has side frame members connected at their forward ends by a channelled arch with vertical side arms, a pair of endless belts mounted to travel in elongated paths having their forward limits near said arch, said paths being disposed in a plane extending rearwardly and upwardly, a pair of arms mounted in the pannelled side arms of said arch, for vertical adjustment relative therto, and a pair of plough blades carried by the lower ends of said arms.

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

Unrefined Sugars.	One Month ending September 30th. 1926. Tons.	One Month ending September 30th. 1927. Tons.	Nine Months ending September 30th. 1926. Tons.	Nine Months ending September 30th. 1927. Tons.
Poland	....	4,623	13,074	5,871
Germany	248	3,619	7,849	4,305
Netherlands	....	....	....	....
France	....	....	....	....
Czecho-Slovakia	....	....	342	1,248
Java	....	2,053	....	9,513
Philippine Islands	....	....	....	....
Cuba	55,161	36,949	207,055	299,143
Dutch Guiana	....	....	....	....
Hayti and San Domingo	15,474	24,311	101,804	129,994
Mexico	....	....	....	....
Peru	10,985	5,351	78,875	93,847
Brazil	....	440	95	31,360
Union of South Africa	13,525	9,123	40,108	15,734
Mauritius	446	....	151,031	127,281
Australia	....	499	127,102	15,309
Straits Settlements	....	....	....	....
British West Indies, British Guiana & British Honduras	5,824	5,600	96,380	79,392
Other Countries	388	24,060	16,285	50,171
Total Raw Sugars	**103,052**	**116,627**	**840,002**	**863,168**
Refined Sugars.				
Poland	....	....	9,280	3,489
Germany	4,990	4,342	17,214	9,723
Netherlands	22,314	11,628	183,345	147,214
Belgium	1,789	1,291	9,378	6,376
France	....	....	....	....
Czecho-Slovakia	17,389	3,463	240,046	96,806
Java	....	....	....	....
United States of America	449	5,425	11,472	41,059
Canada	7,030	4,423	56,762	52,357
Other Countries	768	2,011	10,537	17,564
Total Refined Sugars	**54,729**	**32,583**	**538,034**	**374,587**
Molasses	14,737	29,327	119,892	110,094
Total Imports	**172,518**	**178,537**	**1,497,928**	**1,347,849**

EXPORTS.

British Refined Sugars.	Tons.	Tons.	Tons.	Tons.
Denmark	135	151	983	957
Netherlands	27	29	315	295
Irish Free State	2,746	7,206	33,927	37,769
Channel Islands	118	93	616	612
Canada	....	....	....	....
Other Countries	566	2,547	21,106	26,143
	3,592	10,025	60,948	65,776
Foreign & Colonial Sugars.				
Refined and Candy	179	173	2,100	3,830
Unrefined	30	563	1,022	1,819
Various Mixed in Bond	....	....	....	....
Molasses	20	20	2,231	232
Total Exports	**3,821**	**10,781**	**66,301**	**71,657**

Weights calculated to the nearest ton.

United States.

(*Willett & Gray.*)

(Tons of 2,240 lbs.)	1927. Tons.	1926. Tons.
Total Receipts, January 1st to Sept. 28th	2,408,868	2,649,345
Deliveries ,, ,,	2,388,753	2,488,466
Melting by Refiners ,, ,,	2,378,098	2,485,000
Exports of Refined ,, ,,	78,000	73,000
Importers' Stocks, September 28th	134.977	169,535
Total Stocks, September 28th	186,849	219,279
	1926.	1925
Total Consumption for twelve months	5,671,335	5,510,060

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1925, 1926, AND 1927.

(Tons of 2,240 lbs.)	1925. Tons	1926. Tons	1927 Tons
Exports	3,760,186	3,164,954	3,032,457
Stocks	822,799	945,416	783,717
	4,582,985	4,110,370	3,816,174
Local Consumption	97,000	95,000	96,000
Receipts at Ports to August 31st	4,679,985	4,205,370	3,912,174

Havana, August 31st, 1927.

J. GUMA.—L. MEJER

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR NINE MONTHS ENDING SEHTEMBER 30TH, 1925, 1926, AND 1927.

	Imports 1925. Tons.	Imports 1926. Tons.	Imports 1927 Tons.
Refined	527,145	538,031	374,587
Raw	1,010,378	840,002	863,168
Molasses	130,853	119,892	110,094
	1,168,376	1,497,928	1,347,819

	Exports (Foreign). 1925. Tons	Exports (Foreign). 1926 Tons	Exports (Foreign). 1927. Tons.
Refined	1,753	2.100	3,830
Raw	559	1,022	1,819
Molasses	383	2,231	232
	2,695	5,353	5,881

	Home Consumption 1925 Tons	Home Consumption 1926. Tons.	Home Consumption 1927 Tons
Refined	533,309	510,919	417,422
Refined (in Bond) in the United Kingdom	654,004	636,266	651,390
Raw	75,828	110,544	106,171
Total of Sugar	1,263,141	1,257,729	1,174,983
Molasses	6,078	4,355	4,659
Molasses, manufactured (in Bond) in United Kingdom	42,344	47,254	67,327
	1,311,563	1,309,338	1,246.969

STOCKS IN BOND IN THE CUSTOMS WAREHOUSES OR ENTERED TO BE WAREHOUSED AT SEPTEMBER 30TH, 1927.

	1925. Tons	1926. Tons.	1927. Tons.
Manufactured from Home Grown Beet	—	100	250
Refined in Bond	45,750	52,650	66,300
Foreign Refined	24,900	134,150	37,050
,, Unrefined	222,800	166,000	130,700
	293,450	352,900	243,300

United Kingdom Monthly Sugar Report.

Our last report was dated September 9th, 1927.

The tendency of the London Market has been flat and easier, and prices have dropped daily. The premium has now practically run off near at hand sugars.

The Terminal Market has been chiefly concerned with the liquidation of accounts and no fresh speculative movement has been started. Fairly large dealings took place in September from 15s. 10½d. down to 14s. 9¾d., and finally, during the last two days about 12,000 tons of sugar was tendered, consisting chiefly of old granulated, having been in store for about 18 months to two years.

Heavy hedge sales have been made by the Home Grown interests and December sold down to 14s. 0¾d., whilst the premium ruling on October has practically disappeared. Forward deliveries have declined in sympathy and March sold down to 16s. 0¾d., May 16s. 3¾d., August 16s. 6d. The latest prices are, October 14s. 0¾d., December 14s., March 16s., May 16s. 3d., August 16s. 6d.

The demand for White Sugar has been very poor, the trade continuing their waiting policy in the hope that they will be able to buy the Home Grown sugars much cheaper when the campaign is in full swing. Ready Granulated sold down to 16s. and October is offering at 15s. 3d., whilst November/December can be bought at 14s. 7½d. second hand.

The Spot Market has steadily declined from 29s. 7½d. to 28s. and Granulated stored a long time has been sold as low as 27s. 6d. German Granulated was sold during the month, and a few thousand tons have been imported into London.

Some of the Home Grown factories are already offering new sugar, but owing to the lateness of the crop the majority will not be free sellers until the latter part of October. The latest prices for this class of sugar are Spot 29s., October 28s. 9d., November/December 27s. 10½d.

The refiners have not received such a large share of the business recently and in consequence they have made a series of reductions during the month. On September 10th prices were reduced 6d. per cwt., September 26th they were again 6d. lower, and October 10th a further decline of 6d. was registered. The latest prices are No. 1 Cubes 32s. 6d., London Granulated 29s. 7½d.

Raws have been very quiet, and although no Cuban business has been done, Perus, Brazils and Argentines 96 per cent. have been sold from 13s. down to 12s. c.i.f. A fair business has been done in European 88 per cent. beet from 12s. 6d. to 11s. 10½d. f.o.b.

In America the market has been affected by the restriction rumours in Cuba. On the 4th October a Bill was passed by the Cuban Senate, giving the President power to limit the crop. The President is to be advised by a Committee of five as to the size of the crop each year, but it is generally thought that the crop this year will not be allowed to exceed four million tons. This news was apparently discounted in America, for the Futures Market declined about 10 points and altogether America has now fallen about 20 points from the top. Raws in the States have also been sold down to 2⅞ c.i.f. New York. The stocks in Cuba to-day amount to 1,130,000 tons, which is 60,000 tons more than last year.

The weather on the Continent has been mostly unfavourable, except during the last week when sunshine and warmer temperatures have been experienced. F. O Licht has made his first estimate of the beet crop as follows :—

	Tons.		Tons.
Germany	1,700,000	**Russia**	**1,325,000**
Czecho	1,300,000	**Poland**	**660,000**
France	880,000	**Hungary**	**165,000**
Belgium	300,000	**Italy**	**300,000**
Holland	250,000	**England**	**275,000**
Spain	240,000	Other countries	706,000
		Total	**8,101,000**

21, Mincing Lane,
London, E.C.3.
10th October, 1927.

Arthur B. Hodge,
Sugar Merchants and Brokers.

THE

INTERNATIONAL SUGAR JOURNAL.

☞ All communications to be addressed to "The International Sugar Journal," 2, St. Dunstan's Hill, London, E.C. 3.

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed

No. 347. NOVEMBER, 1927. Vol. XXIX.

Notes and Comments.

The Disposal of the Surplus Cuban Sugar Supply.

The principal event of the past month on the sugar market has been the surprise disposal by the newly-formed Cuban Sugar Commission of the whole of the surplus stock of 150,000 tons of sugar which, under the new Machado Laws, was to have been taken over from the unsold stocks lying in the Cuban warehouses. This huge parcel has been sold to Messrs. Tate & Lyle at a price approximately 45 points below prevailing U.S. market values, viz., at 11s. 7½d. c.i.f. This is reckoned to be equal to 2·34 cents f.o.b. Cuba, or say 2½ cents c. & f. New York, whereas New York prices that day were $2\frac{15}{16}$ cents c. & f. equivalent to about 2·79 cents f.o.b. This figure of 2·34 cents is undoubtedly well below the cost of production in Cuba; in 1925 the Czarnikow-Rionda Company estimated that the lowest price at which the most favoured Cuban plantations could place 1 lb. of 96° sugar f.o.b. steamer was 2½ cents.[1] And just recently Colonel Tarafa, the President of the Cuban Commission, is reported to have declared that a Cuban producer should receive from 3¼ to 3¾ cents per lb. to give a reasonable profit.

The world market was taken by surprise by this speedy step on the part of the Cuban Commission; and opinions so far expressed have shown considerable divergence of view. On the one hand, it is agreed that in disposing of this amount of the Cuban surplus the decks have been cleared to that extent and the new season will open with a minimum of old stock in Cuban warehouses. On the other hand, it is not certain that United States interests in Cuba will take kindly to the enforced sale of their sugar at unremunerative prices, or that the consuming interests in the States will acquiesce indefinitely in so large a parcel of sugar being sold to Europe at 44 points or more below what the U.S. market would have to pay. Finally we do not suppose that the American refining interests will look with favour on all this refinery raw material going to European refineries, when they themselves are understocked. But this action of the Cuban Commission must be judged as only one step in a series, destined, so they declare, to stabilize the industry and obtain a price for sugar that will cover the cost of production plus a small profit. The next step is apparently the visit

[1] See *I.S.J.*, 1925, 598.

to Europe of the Chairman of the Commission, Colonel TARAFA, in the hope of inducing some of the European exporters of sugar to co-operate with Cuba in an attempt to regulate the production of sugar to the world's requirements. If he succeeds in his venture, some good may be done in stabilizing prices at an economic level. But with the increase in the European crop, surpluses for export are multiplying, and we have France once more after a long interval of years sending her sugar to foreign markets and scheming (if rumours are correct) to export in the coming season 200,000 tons at a loss, which would be recouped four-fold by an increase in the domestic price due to the resulting scarcity of the remaining sugar.

Intelligent anticipation assumes that the new Cuban crop will be no more than four million tons. But the official decision is still awaited, as is the decision whether grinding shall commence on January 1st, or be deferred further till January 15th. Financial and factory interests in Cuba seem content to give the President a free hand to decide what is best for the industry; if there is any dissent it comes from the planting community who do not see the justice of having to sell less cane than they happen to have grown.[1] The new rules and regulations in fact do not appear to make any provision for adjusting field output to the output authorized for the factories themselves. That is left for the colonos to anticipate, months in advance.

Competition of Cuban with Empire Sugar.

The Sugar Federation of the British Empire, a recently constituted body which aims at co-ordinating the interests of all those engaged in sugar industry in the Empire, including the sugar refiners at home, is finding that some of these interests are on the face of them antagonistic to one another. The big refining firm of TATE & LYLE, in an endeavour to secure profitable business during the least remunerative part of the year, have as above mentioned bought up a big parcel of Cuban sugar on very advantageous terms, which should help to keep their refineries going through the winter. But the Federation see in this transaction a danger to the Empire sugar industry, and have communicated their fears to the press. This recent purchase of Cuban sugar, they also point out, is under the actual cost of production and is considerably below the price at which raw sugar can be produced in any part of the British Empire; this coupled with the existence of large surpluses in other foreign countries they regard as a positive danger to the expansion of the Empire industry.

"In addition to Cuba, other foreign beet and cane-growing countries are looking to the United Kingdom market to relieve them of their surplus production, and if they sell their sugars at anything approaching the price of the Cuban parcel, a setback to the Empire industry must follow. The Empire industry in the last few years has shown a very satisfactory response to the Government's policy of encouraging production within the Empire by means of the stabilized Imperial preference. But unless measures are promptly taken to deal with the new world conditions as affecting the British market, that policy will be neutralized very rapidly."

But although it is the home refiners' recent purchase that has given rise to the dangerous situation above referred to, the Federation are also concerned at the competition these old-established home refining industries are faced with—not only from the subsidized home beet sugar but also from the large increase in white sugar production in Czecho-Slovakia, Poland

[1] This aspect of the matter was fully stated by our Havana Correspondent in our September issue (page 466).

and other countries, which countries are sending their surpluses to this market on terms that are only possible because of the fiscal support in one way or other given by the respective Governments. The Federation therefore are carefully considering what representations can be made to the Imperial Government with regard to the whole situation.

This is a desirable step to take, but it is obvious on the face of it that the various interests concerned—Home Beet, Home Refining, Empire Cane Sugar (not to mention the Home Consumer)—are so conflicting that it seems doubtful to us whether they can be sufficiently reconciled to allow a united front to be made in any approach to the Government. The competition of home beet with the home refiners is undoubtedly severe for the three or four months of the campaign, but we doubt whether the Government are likely at this stage to accept any suggestions for altering the system while the ten years of declining subsidy are in existence. The dumping in this country of foreign white sugar is a menace that threatens all three main producing interests, and is the most likely direction in which alleviation might be offered by the Government. But the refiners by accepting a parcel of dumped Cuban sugar have introduced a fresh complication, for the interests of the Empire producer of cane sugar are thereby jeopardized if this transaction does not prove an isolated instance but is to be an annual achievement. Is then the dumping of foreign refined to be neutralized by fiscal expedients, but the dumping of foreign raws to be permitted? Refiners would like to see both Imperial Preference and Home Beet Subsidy strictly confined to *raw sugar* production. This, however, would penalize, inter alia, such Empire sources as Mauritius where the determination has recently been renewed to turn out the crop as white sugar and not as raws, and to use every effort technically to produce an improved quality of the said white sugar. The Empire production of white sugar has, it is true, recently suffered a setback by the decision in South Africa to revert to raw sugar production in the interests of a common co-operating refinery; but the process has so much to be said for it from the point of view of technological achievement and promise, that it cannot be lightly legislated against.

The above is only a brief indication of the difficulties that face those attempting to reconcile the divergent interests existing. The refiners certainly have a claim for some consideration, especially in respect to the dumping over here of foreign white or refined sugar. But if they are to be free at the same time to import foreign raws at a dumping price, they simply transfer the disabilities of the situation to the Empire cane sugar interests, who will naturally complain that the Preference they are supposed to receive is neutralized by the dumping transactions. It is clear then that the Government cannot elect to save the refiners from the competition of foreign refined and yet ignore the new threat to Empire cane sugar which the recent transaction of the Cuban Government with our refiners has staged the last few weeks. This new factor indeed comes at a distinctly unfortunate moment, as it vastly complicates matters and throws fresh fuel on the fires of contending sugar factions. The Government will have to make some attempt to solve the problem, for they cannot very well leave matters indefinitely as they are at present; but their task is certainly not an enviable one, and whatever solution seems to them the most equitable in the circumstances will have to secure the approval of political expediency, or one difficulty will only be solved at the expense of creating another.

Recent Company Reports.

Leach's Argentine Estates.—For the year ended March last LEACH's Argentine Estates record a loss of £73,311 or almost the same sum as in the preceding year, after charging depreciation, debenture interest, etc.; and this after costs of production had been reduced 16 per cent. by exercise of the strictest economy in all departments. Part of the loss was due to the policy of the Argentine industry exporting surplus sugar, even at a loss. The sugar crop for 1926 was 440,000 tons of which Leach's Estates manufactured 28,563 tons. A satisfactory feature of this Company's accounts is the depreciation fund which stands at about half a million sterling, and its influence would be quickly reflected in the event of any decided recovery in the sugar market. But the Argentine crops of the last two years have been much in excess of consumption.

Sir J. L. Hulett & Sons, Ltd.—This well known Natal firm of tea and sugar growers for the year ended April last showed an increase in net profits by about 50 per cent., viz., £92,556, as compared with £61,962 in 1925-26; this is the best result with one exception in the past ten years. The sugar output amounted to 71,876 tons or some 591 tons short of the previous year's total which was the highest on record. But as frosts caused a loss of over one thousand tons, the crop should really have broken new records. Prices were stable, the sucrose content of the cane was higher, and the recovery at the mill larger. During the year the Company's South Coast Junction Refinery was sold to a new company for £528,117. A dividend of 13 per cent. is being paid, as compared with 8 per cent. in 1926, and £32,380 carried forward.

Sena Sugar Estates.—The Sena Sugar Estates, in Portuguese East Africa, made for the year 1926 a net profit of £49,206, which compares with a net loss of £118,673 for the preceding year. But the year 1925 was an abnormal year owing to extensive flood losses, and comparisons are more fittingly made with 1924. In this earlier year while costs of production were approximately the same as in 1926, the average price was £3 per ton more than in 1926. The directors therefore consider the results disappointing. Costs of production are still too high, but are due to the aftermath of the flood resulting in much immature cane having to be crushed, and the estates produced considerably less cane than the capacity of the factories. The sugar crop amounted to 42,428 tons as compared with 22,692 tons in 1925, and 39,018 tons in 1924. For 1927 30,149 acres are under cane as compared with 21,393 acres in 1926. With the addition of £4933 brought in there is this year available for disposal a sum of £54,139. The preference dividend has been met, leaving £31,639 from which £25,000 has been put to depreciation reserve and the balance of £6139 carried forward. The ordinary capital of £1,200,000 again goes without a dividend.

Incomati Estates.—The report of the Incomati Estates for the year 1926 shows a net profit of £57,650. Interest on Debentures, Preference, and Preferred Ordinary shares is being met, but the Board have preferred not to pay any interest on the Ordinary shares, but to carry forward £33,523, owing to the fact that expenditure on capital account has been heavy and debentures have shortly to be redeemed. The output of sugar was 9601 tons, as compared with 8865 tons in 1925, and the costs of manufacture were £6 0s. 9d. per ton, which includes losses on deposits equal to 9s. 3d. per ton. The sugar crop realized £157,815, equal to an average of £16 8s. 4d. per ton. Of the crop, some 3000 tons was marketed in London and 5221

tons in Lisbon. The new Portuguese Government bonus comes too late to benefit the 1927 crop, but is expected to improve the average selling price of the 1928 crop.

Governmental Export Credits Guarantee Scheme.

A problem confronting all those engaged in the export trade in the United Kingdom is that of giving credit to purchasers overseas. From all markets of the world reports are received that in the fight for orders credit is an ever-increasing factor, and in many instances credit plays a part equally important with the price itself. In fact, buyers overseas as a condition of placing orders with British firms insist upon credit terms which many exporters find it difficult to give. In other instances a larger risk of bad debts is involved than firms quite justifiably care to carry uncovered by any form of insurance.

The realization of these circumstances led the Department of Overseas Trade two years ago to appoint an expert committee to investigate the matter, and as the result of its findings the "Export Credits Guarantee" scheme of the D.O.T. has come into being. Acting on the advice of the Chambers of Commerce of the country, the Department has produced a floating Contract scheme, drafted in simple language, under which the Government insures exporters against bad debts by taking up 75 per cent. of the credit risk. This contract has been prepared in a manner to be of general utility to all trades, but where it does not fit in with the usual practice or custom of a particular trade it is capable of minor alterations.

It is a fundamental condition that goods to be covered by the scheme must be wholly or partly produced or manufactured in the United Kingdom; and, secondly, the Department's assistance is limited to transactions which are dealt with on the basis of bills of exchange. But within these limits the Government guarantee enables exporters to insure their debts and so enlarge their export trade without additional risk, and thereby increase profits and reduce overhead charges; to finance a larger turnover by providing them with additional financial facilities; and to discount their bills of exchange at the lowest rates possible.

Copies of the conditions, and applications forms, can be obtained from any Chamber of Commerce, from Banks, or from the Exports Credits Guarantee Department, 31, King Street, London, E.C.2.

Next crop about 25 per cent. of the sugar made in Porto Rico will be produced in factories employing the Petree-Dorr process. This very successful improvement expands the functions of the Dorr clarifier in such a way that it entirely eliminates the filter-press station, while at the same time improving the clarification, owing to its application of the principle of double defecation. Centralization of control over both clear juice and mud, combined with the continuity of the process, reduces the labour requirements, one man per shift replacing the crew usually employed at the defecators and filter-press station.

"Farm studies reveal that the influence of beet culture is usually noticeable after a period of three years from the time of its introduction. All kinds of cereals if planted in a good rotation on a beet farm give a higher average yield than when planted on beetless farms, the lowest average yield of cereals on beet farms being greater than the highest average on beetless farms. The results are due not entirely to the beet as such, but to deeper culture, better fertilization, and more thorough tillage in growing beets successfully. The millions of fibrous roots of the sugar beet add an average of one ton of humus per acre; the root channels aerate the lower soil strata; the channels store winter moisture; while by-products of the beet increase the stock-carrying capacity of the farm and manure production.'

Home Beet Sugar Notes.

According to a report of the Ministry of Agriculture on the Progress of the Beet Sugar Industry in Great Britain, the number of factories at work on this year's crop is 19, of which five will operate for the first time and five will have greatly enlarged their manufacturing capacity. The total area under sugar beet in 1927 is returned at 229,200 acres—221,700 in England and Wales and 7500 in Scotland. On the basis of only the same yield this year as last—8·6 tons—it would be reasonable to expect a total crop of about two million tons of beet and a production of white sugar of, say, 260,000 tons, or slightly less than two months' supply of sugar for Great Britain.

The following statement of the Board of Agriculture illustrates the development that has taken place since the 1924-25 season :—

	Manufacturing Season.			
	1924-25.	1925-26.	1926-27.	1927-28 (Estimated)
Acreage under sugar beet	22,637..	56,243..	129,463..	229,200
Number of factories..............	3..	9..	14..	19
Sugar beet delivered to factories (tons)	183,713..	431,185..	1,117,072..	2,000,000
Total production of sugar	23,915.	51,784..	153,487..	260,000
Total production of molasses	5,701..	13,545..	37,500..	65,000

Profit-sharing scheme for a new factory at Chichester.—The Anglo-Dutch Group of beet sugar manufacturers who operate the factories at Cantley, Kelham, Ely, Ipswich and King's Lynn have undertaken, at the request of the West Sussex Branch of the National Farmers' Union, to build a new factory for the season of 1928 on a site near Chichester provided that sugar beet from at least 8000 acres within a radius of 30 miles has been secured on definite contracts for three years within a reasonable time. The factory will involve an outlay of about £450,000 and the whole of the capital has been arranged for.

The beet contract contains features of special interest. For the three years 1928-30 a fixed guaranteed price for beets of 41s. per net ton delivered will be paid on the basis of 15½ per cent. sugar content instead of 46s. per net ton as agreed with the National Farmers' Union for existing factories which have had the benefit of the highest rate of subsidy and therefore have been able to make some provision for the risks of the sugar market. The sugar content bonus remains at the agreed rates of 3s. up to 16½ per cent. and 3s. 4d. for each 1 per cent. in excess of 16½ per cent. As last year the average sugar content in Sussex was approximately 17½ per cent., the price for beets on this basis would be 47s. 4d. per ton. From this point, however, the principle of profit sharing has been adopted. Each grower during the seasons 1928 and 1929 will receive 6d. per net ton for each 1 per cent. paid in dividend by the factory in excess of 10 per cent. free of tax. In the third year the bonus will be calculated on this basis upon the net profits available for dividend during the three years whether distributed or not, after setting aside 16 per cent. per annum for depreciation, 10 per cent. per annum for dividend, and the amount of bonus already paid. It is a requirement under the contract that the growers shall be part-owners of the factory, the grower undertaking to receive a transfer of three shares per acre per annum, payable from his beet account. The price agreed is par plus 5 per cent. interest less dividends paid to date upon the shares transferred. The maximum number of shares required to be taken up by the growers is 75,000 so that if the acreage exceeds 8000 acres, a proportionate reduction can be made of each grower's obligation to take up shares if he so wishes. These shares are to be " blocked "

for six years (i.e., not transferable) as an earnest for future support to the factory in the provision of raw material, and a corresponding number of shares held by the Directors will be similarly "blocked" to ensure continuity of the management. In addition, a Director will be appointed to represent the growers so that co-operation between the grower and the factory may be secured in as complete a form as possible to ensure the permanent success of the enterprise in the service of British agriculture.

New factory projects.—After all there is a prospect of a factory being erected in the Bridgwater district of Somerset, for following on the rejection of the terms to the farmers by the Anglo-Dutch group (as mentioned in our last issue) another corporation has come forward prepared to pay the price agreed to by the Farmers' Union and they have purchased a site for the factory. The promoting Company is said to be British Sugar Developments, Ltd., of London.—It is reported that, after all, the Beccles scheme has had to be abandoned by its promoters. The reasons given are that the Board of Agriculture was opposed to the erection of a factory so near the Cantley sphere of operations, and the Norfolk Fishery Board was hostile to the proposal in view of the proximity of the site to the well-known Oulton Broad.

This season's new factories.—Allscott, Bardney, King's Lynn, and Selby factories are all reported to be starting under good auspices this autumn. And there is also the small experimental factory at Eynsham.

British Empire Sugar Federation Proposals.

At a meeting of the Sugar Federation of the British Empire held on October 31st last, the grave situation arising from the dumping of foreign sugars in this country was discussed. It was decided to frame representations to be placed before the Government at an early date on the necessity for immediate action to prevent permanent injury to the refining industry in Britain and the producers of sugar in all parts of the Empire. The Federation's policy of free-entry of all Empire sugars sold to the British refiner was reaffirmed.

It was decided to render all possible assistance to the expedition of the United States Department of Agriculture to New Guinea in their endeavour to find indigenous varieties of disease-resistant cane, the production of new cane varieties being considered a most important factor in the agricultural future of the industry.

A report by the Deputy Director of the Federation, Mr. HAROLD T. POOLEY, on sugar production in the Caribbean area was discussed and approved. Arising from this report it was decided to form a Committee for the co-ordination of the sugar research work going on in various parts of the Empire as in foreign countries, particularly under the heading of Agricultural, Chemical, Mechanical and Economic Research, the last to include special reports; the collection of statistics and the study of cost accounting for tropical agriculture and the working of co-operative systems. It is understood that travelling representatives of the Federation will proceed at a later date to the sugar producing countries for this purpose.

The Bureau of Chemistry and Soils of the U.S. Department of Agriculture, Washington, recently formed, will be directed by Dr. HENRY G. KNIGHT, with Dr. C. A. BROWNE, chief of the former Bureau of Chemistry, as associate-chief. Dr. BROWNE will at his own request devote his major energies to research work in chemistry.

The Sugar Industry in Queensland.

By J. F. REID.

Crop prospects.—Reduced yields followed naturally the prolonged dry spell of last year. The dry conditions affected principally that portion of the sugar belt from Townsville southwards and were felt acutely at Bundaberg, on the Isis and in the Moreton. On the Burdekin, though severe, the losses were light comparatively. On the Herbert and round about Cairns crops were good.

Last year the total area under cane was 266,519 acres, about 3000 acres less than the total cropped in the preceding season. This was the first reduction for some time, as the acreage had been increasing steadily since 1920, when it was only 162,619 acres. The area from which cane was crushed in 1926 was 189,312 acres, just about the same as in 1925. The weight of cane per acre—15·45 tons—was not so high as in 1925, when it was 19·36 tons; this was due to the abnormal rain shortage. The yield of sugar per acre was 2·06 tons, as against 2·56 in 1925. The total quantity of cane harvested reached the total of 2,925,662 tons, from which 389,272 tons of 94 net titre raw sugar was manufactured. The cane harvested in the previous year, 1925, was 3,668,252 tons, giving a yield of 485,585 tons of raw sugar, and constituting a record for Queensland.

The quantity of cane necessary to make one ton of sugar was 7·52. The figure may, to a large extent, be taken as the index of efficiency of Queensland mills which has greatly increased in recent years, but it is also due, in part, to the better and more suitable varieties of cane now grown by our farmers. This work is assisted by the operation of the Cane Prices Act and the work of the Bureau of Sugar Experiment Stations, which is directed by Mr. H. T. Easterby.

Local consumption and export.—In 1926, the yield being beyond home requirements, it was found necessary to export 74,777 tons, but this was 136,223 tons less than the quantity exported in 1925. The price per ton for sugar paid to the mills was £24 10s. 10d. as against £19 10s. 7d. paid for the 1925 crop. The percentage of the sugar made which went into home consumption was 81·3248 and the net value of the export surplus was £14 18s. 10d. per ton. A satisfactory point to note is that this was a much better price for export sugar than was received in 1925, when it was only £11 5s. 9d. per ton. The present day consumption of sugar in Australia is estimated at about 330,000 tons.

Sugar cane by-products.—Some 14½ millions of gallons of molasses were produced, of which 4,748,000 gallons were allowed to run to waste. The manufacture of power alcohol from waste molasses is now, it is pleasing to observe, one of Australia's infant industries and the National Power Alcohol Distillery at Plane Creek, near Mackay, is producing spirit commercially. Greater interest is also being manifested in the making of celotex, and there is every reason to say, at the time of writing, that another new industry, having for its basis the utilization of waste cane products, will be established shortly in this State.

Seasonal outlook.—Climatically, the seasonal outlook is, at present, good. The dry spell in the sugar districts broke in December and since then good growing rains have been general throughout the sugar belt. In fact, in some districts, rain has been excessive, particularly so in the Herbert River Valley where early in the year serious floods occasioning a regrettable loss of life occurred. Many properties were damaged through a heavy overburden of silt being deposited on them by flood waters. The abnormal rainfall was

coincident with a disastrous cyclone which devasted some of the far Northern sugar areas.

White labour (British) in the industry.—In the July issue of the *International Sugar Journal*, page 366, the remarks of a *Times* (London) correspondent are quoted to the effect that labour contracts for the present season's harvesting in Queensland show that "cuts" have been allotted to only nineteen British subjects among 742 cane-cutters, the rest being made up of Italians, with some Spaniards, Jugo-Slavs, and Hindoos. This statement is quite misleading and it would be well to make it plain that it applies actually to only one particular district in this State, the South Johnstone, in which was centred recently serious industrial trouble. As a matter of fact, out of 28,000 men engaged on the Queensland sugar industry only 10 per cent. are non-British by birth. In most sugar districts, particularly in the South, the labour employed in field and mill is almost entirely British.

Summary of Results at the Factory of the Imperial College of Tropical Agriculture, Crop 1927.[1]

By W. SCOTT, B Sc., Professor of Sugar Technology.

The College factory was operated from the 14th of March to the 21st of May, grinding for ten hours daily, but owing to the unseasonable weather, the cane was poor. Demerara Crystals, Refined White Crystals, Special Greys and Molasses Sugar, were manufactured. The following figures are taken from the manufacturing Report for the crop :—

	Per cent.
Sucrose in cane	9·96
Fibre in cane	13·61
Sucrose in bagasse	4·48
Fibre in bagasse	43·91
Moisture in bagasse	49·94
Normal juice, Brix	15·17
Sucrose	11·83
Apparent purity	78·02
Glucose ratio	15·42
Final molasses : Apparent purity	33·34
Cane ground : Tons	1288·92
,, per hour, tons	2·89
Sugar made	93·56
Tons cane per ton sugar	13·77
Sucrose in juice per cent. : Sucrose in cane	86·07
Sucrose in sugars per cent. : Sucrose in cane	69·81
Sucrose in sugars per cent. : Sucrose in juice	81·11
Fuel oil consumed, tons	55·11

The recovery figures cannot be compared with corresponding figures from commercial factories on account of the very intermittent nature of operations of the College factory, and also owing to the fact that refining losses are included.

The principal features of the instructional part of the work were as follows : For several weeks previous to grinding the students were assigned for a definite number of hours weekly to the factory, where, under supervision, they took part in the overhaul and assembly of the machinery ; thus familiar-

[1] Abridged from *Tropical Agriculture* (Sugar Supplement), 1927, 4, No. 927-931.

izing themselves with the construction of the various parts of the factory equipment. During this period preliminary analyses on laboratory samples of juices and syrups were made in order to adjust methods and develop team work in the determination of phosphates, silicates, pectin, pentosan, total colloids, etc. This was in preparation for the research work on factory samples.

During the crop the students divided their time between the factory and the laboratory. Their laboratory duties included analytical work bearing on both chemical control and research. In the factory, the practical features of factory control and operation were emphasized, and the 4th year students were given a certain amount of responsibility in supervising operations. They were also given every opportunity of taking a direct part in the operation of various stations, particularly in the handling of the vacuum pan.

MILLING.

A series of experiments was carried out with a motor-driven 10 in. and 12 in. laboratory mill, in order to determine to what extent preliminary preparation of cane could help small factories with a three to six-roller mill when whole cane, pieces in 3 in. lengths, and pieces cut ⅜ in. or less, were milled. But the results obtained giving extractions of 86·41, 84·18 and 75·06 per cent. for these three preparations respectively showed that without efficient surface drainage, pressure regulation and maceration, an actual drop in extraction is experienced with more efficient preparation of cane owing to re-absorption of juice and greater resiliency of the finely divided cane.

VARIETY EXPERIMENTS.

The yield of cane from each of the College Experimental plots was ground separately, the results recorded being as follows :—

	CANE.		CRUSHER JUICE.		
VARIETY.	Per cent. Sucrose.	Per cent. Fibre.	Brix.	Sucrose.	Purity.
SC 12/4	11·70	11·52	17·03	14·64	85·96
B.H. 10(12)	10·98	9·84	15·77	12·62	82·50
Ba. 11569	10·94	10·68	15·90	12·94	81·67
B. 156	9·71	10·32	14·80	11·55	78·04
Crystalina	9·67	9·42	14·50	11·40	78·62
Ba. 6032	9·45	11·50	14·00	11·12	79·43

The order in which those varieties occur in the Table follows closely their usual classification in Trinidad. SC.12/4, however, usually comes second to BH.10(12).

LOSS IN WEIGHT OF CANE BY EVAPORATION.

A cartload of cane weighing 2162 lbs. arrived at the factory at 9-30 a.m. It was unloaded on the yard in the usual way ; then reloaded and weighed at 1-45 p.m. The cane then weighed 2084 lbs. showing a loss in weight of 78 lbs. or 3·67 per cent. Another cartload weighing 1819 lbs. was left on the yard from 8 a.m. to 12 noon ; and was found to have lost 38 lbs. or 2·08 per cent. The average loss of weight in four hours combining the results of both experiments was 2·91 per cent. Those experiments illustrate the difficulty of obtaining reliable control figures when many hours elapse between the weighing and the grinding of the cane received at a factory. The loss in weight is affected by so many factors that no constant allowance can be made. The logical conclusion is that cane should be weighed immediately before being placed in the carrier, though this would mean providing in some cases several scales instead of one.

Elimination of Non-sugars during Clarification.

The entire run covered a sampling period of ten days, six of which were devoted to the best possible clarification by lime and heat ; one each to overliming and underliming ; and two to defecation aided by the addition of calcium superphosphate at the liming tanks. It was found from determinations on mixed juice that the percentages of the substances investigated show considerable variation, the proportion present depending presumably on the degree of ripeness of the cane and the extraction of the mills.

Pectin, phosphate, silicate and colloidal matter are most completely eliminated by overliming. The appearance of the clarified juice and syrup of the phosphate series was exceptionally good, those products showing no sign of turbidity, being of perfect clarity, brilliancy and colour. Very appreciable quantities of most components are precipitated when the juice is concentrated to syrup, especially in the phosphate series. Pentosan is removed in similar proportions throughout the five series, an indication that this removal is due to the efficient heating practised in the College factory. An almost constant temperature of 215°F. was maintained, but it is uncertain whether the disappearance of pentosan was due to hydrolysis to pentose sugar, or to dehydration and consequent precipitation in the mud. The large percentages of pentosan removed on concentration in the phosphate series are noteworthy, but the actual cause of this disappearance needs further investigation. Nitrogenous substances are removed in larger quantities in both the overlimed and underlimed series than in normal defecation. In underlimed juice those impurities are heated in solution of a *pH* value near their isoelectric point and therefore tend to be largely precipitated. The phosphate content of the juice throughout the crop was low ; and it was not possible with ordinary liming to obtain a really brilliant juice. The additions of phosphoric acid not only produced a very clear and brilliant clarified juice, but the surface tension measurements in this series on both clarified juice and syrup indicated an effective removal of tension-lowering impurities.

The physical measurements included the determination of Brix by the Zeiss Refractometer ; electrical conductivity by Kolrausch's method ; surface tension by Traube's Stalagmometer, and viscosity relative to water at the same temperature by Ostwald's Viscometer. In the determination of H-ion concentration, the quinhydrone electrode gave excellent results ; and it was found possible to use it with alkaline solutions and sulphited syrup if measurements were made rapidly and the first reading taken as the correct one. A tungsten Mn_2O_3 continuous *pH* recorder was fitted up in the factory to the clarified juice discharge pipe by Dr. Hurst. He experienced trouble with the tungsten electrodes, and found it necessary to standardize each one (after standing in the juice for some time) by comparison with the readings of the quinhydrone electrode. The apparatus was then very sensitive to slight changes in *pH*.

Centrifugal Clarification of Syrup and Molasses.

The bowl of the machine used was 6½ in. internal diameter by 5 in. diameter of overflow and gave a separating effect of 800 times gravity at 3350 R.P.M. It was driven by a ¼ H.P. D.C. motor running at 1750 R.P.M.

Hence, the average increase in gravity purity in the syrup series was 1·31 and in the molasses series 2·24. It will be noticed that the increase in purity in both cases is more largely due to an increase in sucrose than to a drop in the Brix. It must however be taken into account that a certain amount of evaporation takes place during the treatment as the syrup and the

molasses are both heated to about 90° C. in order to reduce the viscosity. A slight drop in viscosity was noted in every treated sample. The residue from the syrup samples contained 67·5 per cent. organic matter, and the residue from the molasses, 53·5 per cent. The principal inorganic constituents of the syrup residue were silicates, phosphates, lime, iron and alumina. The inorganic constituents of the molasses residue were principally silicates,

	SYRUP.		MOLASSES.
Average weight of material treated	13280 grms.	..	8376 grms.
„ „ washed and dried residue.	8·25 grms.	..	10·75 grms.
„ „ residue per cent. weight of material	0·063	..	0·127
Speed of bowl	3300 r.p.m.	..	3300 r.p.m.
Temperature of feed	85-90° C.	..	85-90°C.

ANALYTICAL RESULTS.

	SYRUPS.				MOLASSES.		
	Before Treatment.		After Treatment.		Before Treatment.		After Treatment.
Brix	63·20	..	62·80	..	78·29	..	78·18
Sucrose (Pol.)	50·24	..	50·78	..	36·11	..	37·26
Apparent purity	79·50	..	80·86	..	46·12	..	47·66
Sucrose (Clerget)	50·94	..	51·44	..	40·20	..	41·90
Gravity purity	80·60	..	81·91	..	51·35	..	53·59

sulphates, lime, iron and alumina. The presence of sulphates in the molasses residue arises from the fact that the molasses was produced from sulphited syrups, while the raw syrup treated had not been sulphited. Clarification of syrup and molasses affords an interesting field for investigation ; and centrifugal treatment seems to offer the best chances of success.

SUGAR REFINING.

Approximately 6½ tons of sugar were washed to 98·5° purity and used in demonstrating two different processes of refining. Half the melt liquor was treated by the Bach sulphitation method, and the other half was treated with " Suchar " carbon. The " Suchar " liquor was lighter in colour and a better grade sugar was obtained therefrom. Both grades of sugar were, however, considered to be of excellent quality. In the determination of surface tension and specific conductivity on treated filtered liquors it was noted that the surface tension of the " Suchar " liquor was higher, and its specific conductivity lower than the corresponding measurements on the Bach liquor. Those facts would indicate the presence of less colloidal matter and salts in the " Suchar " treated liquor. The refining operation occupied three days, during which 4·58 tons of white sugar were produced.

At Australia House, London, recently, Mr. R. S. FALKINER at a film demonstration of his cane harvester gave an account of the construction and possibilities of this invention, some details communicated being as follows :—In an 11-ton crop the machine cuts and tops at the rate of 20 tons per hour ; while in a 20-ton crop this rate is increased to 40 tons, as the rate of travel is but little less than with the lighter crop. Varied lengths of cane in the field can be dealt with, ranging from 2 ft. 6 in. or 3 ft. up to 7 ft. and 9 ft. of cane, measured after topping. The whole operation carried on by one man on the machine, and the cost per hour should be (with kerosene at 2s. per gallon in Australia) for fuel, oil, and grease, say 6s. ; and man's time, say, 5s. per hour. Reasonably straight cane can be cut, but it is not claimed to deal with down and tangled cane. It is considered that 50 to 75 per cent. of the Australia crop of, say 4 million tons of cane, is straight enough and grown on suitable fields for this machine to operate, and Mr. FALKINER is of opinion that by mechanical loading the present costs of 8s. per ton can easily be reduced to 2s. or less. This would mean (taking only 50 per cent. of the crop) a saving of £600,000 per annum.

Insect Pests of the Empire.[1]

Scientific Investigations at a "Parasite Zoo.'

At Farnham Royal, a pleasant, old-world village in the leafy recesses of Buckinghamshire, scientists are at work upon one of the most serious and baffling problems of the British Empire. A typical English country mansion, with picturesque grounds extending to about seven acres, forms the scene of their operations. Here, in what has been popularly termed a "Parasite Zoo," they are endeavouring to provide new and more effective means to enable the farmer, the forester, and the cattle rearer of the far-off Dominions to combat the innumerable pests that work havoc among crops and animals, and not only impoverish the owners but cause losses which, indirectly, add to the cost of our food and timber.

The extent of the damage done by these pests may be generally indicated by stating that it is estimated that not less than a tenth of the world's crops raised annually is eaten by insects. If we take the tropics alone the figure must be increased to a fifth, and it should be borne in mind that nearly half the British Empire lies within the tropical zone. Such enormous depredations seem difficult to comprehend, yet the difficulty will be lessened if we remember that in Great Britain itself, where the problem is less serious than in some countries abroad, the yearly loss caused by pests is estimated at £30,000,000.

America's bill for the cotton boll-weevil alone has reached as much as £40,000,000 in a year, besides £10,000,000 for loss to cattle and to the hide and leather industries owing to the activities of the warble fly. Canada has to face a yearly loss of £20,000,000 due to field crop pests, and, in addition, between 1914 and 1921, the spruce bud worm did damage to the extent of £7,000,000 among spruce and fir trees. Australia loses every year sheep worth £2,000,000 through the ravages of the blow-fly, while the cane grub takes toll of sugar cane in Queensland to the extent of £100,000.

Enormous losses are caused in South Africa by the codling moth, which infests 20 per cent. of apples in normal years and 40 per cent. in light crop years. In Egypt the pink boll-worm caused damage in 1921 amounting to £10,000,000, while in tropical America, north of the equator (including the West Indies), the damage done every year by sugar cane moth borers reaches a total of £2,000,000.

Disturbed Balance of Nature.

These figures will convey an idea of the gravity of the problem before scientists. Truth to tell, it has been largely caused by man himself, for it is he who, in carrying civilization to the uttermost corners of the earth, has disturbed the fine balance of nature, and all that it means to insect species. Before man comes life is in a state of equilibrium. Insects and parasites exist together, and the preying of species upon each other ensures that none reaches a position of absolute ascendancy. Along comes the pioneering farmer, who clears away the limitless variety of vegetation and substitutes a single crop, Insects which cannot live on that crop depart, leaving those which can to dwell in what, with their departure, has become a paradise without enemies.

Perhaps the pioneer, looking for the best means of gaining a livelihood, decides to grow fruit or rear cattle. He introduces new trees, cattle, and other forms of life previously unknown to the country, and with them come, subtly and unseen, the insects which thrive on them. It is in truth an ideal

[1] Reproduced by courtesy of the *Times* from its Trade and Engineering Supplement of Sept. 3rd.

world for these pests, for more probably than not they manage to arrive without any of those troublesome parasites which prey upon them in their natural home and keep them in check.

The same kind of thing happens in other directions. Weeds, as well as insects, make excellent emigrants, and once in their new surroundings they are exceedingly difficult to eradicate. Many years ago there were no apple orchards in Australia, which was also devoid of prickly pears. To-day the prickly pear covers scores of millions of acres, in spite of every effort to exterminate it. In New Zealand the blackberry plant, introduced by some settler in the past, has become a nuisance. Ordinary means of eradication have failed to rid infested districts of the weed, or even to check its growth on land too steep for cultivation; but there are hopes that it will be possible to deal with it by means of *Coroebus rubi*. This is an insect the young larvae of which work down the root-stocks of the blackberry plants and then up again. One of them will destroy a young plant, and they appear to discriminate surely between the blackberry and the raspberry. These insects have not yet been released for field work, but some of them are under observation in New Zealand at the Cawthron Institute, which is specializing in entomological research.

At present farmers and others in the Dominions rely chiefly upon chemical means of fighting the great army of pests. Spraying is resorted to on a large scale, but it is a by no means perfect method, and there are certain crops to which it is impossible to apply this treatment. In recent years it has become more and more clear that the only satisfactory method is that of biological control, which, in a word, means going back to the lesson of Nature itself and supplying to the countries which are pest-ridden the parasites whose absence has given rise to the problem.

FINANCIAL AID.

The Imperial Bureau of Entomology, the headquarters of which are in London, has been conducting experiments for some time, but it is only recently that a grant from the Empire Marketing Board has made it possible for work to be undertaken on serious lines. The Board has given this financial assistance, first, because damage caused by pests directly affects the food supplies we receive from oversea, and, secondly, because several Dominion Governments have themselves made it clear that they regard the Imperial Bureau's work as of great importance and are anxious to have supplies of parasites at the earliest possible moment. These Governments were probably also aware that such work is already being done at several centres in the United States, and that the results have been very valuable. Indeed, much more money is spent on parasite research in the United States than in this country. Some time ago, when the pink bollworm gained an entrance into that continent a sum of no less than £2,000,000 was promptly voted for its destruction.

Operations at Farnham Royal began recently under the direction of Dr. GUY MARSHALL and Dr. NEAVE, of the Imperial Bureau of Entomology, and though they are not yet fully developed a good deal has been done. In a great number of cases the parasites of the various pests are well known, and the task at the new "Zoo" is merely to breed and export them. One uses the word "merely," but it is not to be supposed that all is simplicity itself, for there are many difficulties, not least of which is the danger of sending out to the Dominions parasites which are not free of hyper-parasites. The latter would, of course, gradually negative everything that had been done. It is also of the utmost importance to export only those parasites which will

confine themselves to the pest to be eradicated; otherwise the Dominions would rid themselves of one problem only to be faced by another equally or more serious.

INSECTORIES.

The greatest care, therefore, has to be taken at every stage of the work at Farnham Royal. The breeding of the parasites is carried out in specially constructed insectories. These consist of large cages framed in teak and covered at the sides with copper gauze so fine that no insect life can either enter or escape. In order to admit the ultra violet rays of the sun, so beloved by pests and parasites alike, the roofs are of vita glass.

In one of these cages one observes a number of bushes thickly infested with the woolly aphis, which does such enormous damage to fruit trees. Here the appropriate parasite has been introduced, and it is left to do its work by laying its eggs in the larva of the aphis and destroying it. At a suitable stage twigs containing the chrysalis of the parasite will be detached and sent to the areas abroad where they are needed.

In another cage the parasite of the scale—an insect that operates on maple and other trees, sucking the juice and destroying them—is being cultivated. In a third and much larger cage, the wood-borer and the blow-fly are being dealt with. A small glass case contains a number of tree logs infested by the wood-borer. Its parasite, quite exceptionally, is a large easily discerned individual, possessing a long protusion like a tail. This contains a thin tube of such penetrating power that the insect is able to bore through the hard wood of the tree with ease. Having reached the grub inside it lays its eggs there, and in due course a new generation of parasites instead of wood-borers is reared. Another glass case contains carcasses of animals needed for blow-fly experiments. Supplies of the parasites of this pest have already been exported to affected areas.

WORK IN THE LABORATORY.

The mansion itself has been turned into a laboratory, in which microscopic and other work is done. It is necessary to make sure that the parasites, when collected, are not only free from their own natural enemies but that they are the correct species. In some instances every parasite, however minute, has to be caught and examined under a powerful microscope before being passed as authentic. For the first of these purposes an ingenious apparatus is brought into use. It consists of a wooden case with holes at the top opening into glass tubes. As the parasites, which are on trays, come to life, they make for the tubes, which afford the only means of obtaining the light they love, and there they are trapped and in due course placed under a microscope. There is a room specially fitted up for the delicate operations of insect photography, and another is to be prepared for the installation of artificial sunlight apparatus in order to provide parasites with the maximum of sunlight.

That is the outline of what has been done up to the present at this remarkable "*Zoo*," but there is still a considerable amount of work ahead. Earwigs do an enormous amount of damage in some of the Dominions, and it is intended to begin very soon the breeding of the parasite which will keep them in check. The codling moth, which ruins millions of apples in Australia, New Zealand, Canada, and South Africa, is to be the subject of research. America has already tried a supposed parasite of this insect, but it proved quite unsatisfactory. The tsetse-fly, the wheat stem sawfly, the corn-borer, and the lucerne flea are other pests which are to be taken in hand

at the earliest possible moment. Even when parasites have been bred and collected there is still the problem of successfully transporting them across thousands of miles of ocean and delivering them in their new home at the right period, and under the right conditions—a task requiring much study.

Thus actual results from the labours of the Imperial Bureau must be slow in making themselves evident, but progress is being made as quickly as possible, and there is little doubt that when the "*Zoo*" is in full operation the pests of the Empire will for the first time be kept under something like effective control, and scores of millions of pounds will be saved annually to trade.

Recent Work in Sugar Cane Agriculture.

A MONOGRAPH OF SUGAR CANE VARIETIES. **A. H. Rosenfeld.** *Journal of the Department of Agriculture of Porto Rico. Vol. XI, Nos.* 1-4, 1927.

Any attempt to describe the numerous sugar cane varieties with sufficient conciseness and accuracy to make them readily distinguishable has always evoked our heartiest approval. With the continued arrival of new seedlings in the field, matters are rapidly becoming extremely complicated; and descriptive botany is coming into its own again in cane literature. We have now a certain general knowledge of the morphology of the plant, at any rate far in advance of what we had a quarter of a century ago. But the genius in classification has yet to come and, meantime, the more descriptions we have by competent observers in different countries the better—to serve for his raw material. And this point should be stressed, that there should be as many different centres for this work as possible; for we do not as yet know which are the characters of major significance and which, although sometimes very striking, are liable to change materially with the environment. And this knowledge can only be slowly built up by the work of many observers. That such descriptions are wanted need not be emphasized; it is a matter of common remark, and commencements are being made in a number of places; what is wanted is a fairly stable scheme on which such descriptions should be founded, and that this scheme, for comparative purposes, should be universal. The later descriptive work in Porto Rico is based on a simple scheme developed by F. S. EARLE, during the short period spent by him in the island, and on the whole it appears to be a fairly satisfactory one.

The present work by A. H. ROSENFELD appears from its title to be an ambitious one; but on perusing it, it is found to deal only with those cane varieties which have been grown and tested in Porto Rico. Nevertheless it is a notable achievement, and we only hope that its volume will not deter workers in other countries from adding their quota to the desired universal compendium. In any case their work will not be so onerous as that in Porto Rico, because there cannot be many countries where such numbers of canes are still being grown in a single central collection, and it is a *sine quâ non*, that the growing plants should be examined in as complete a manner as possible. The descriptions will, of course, be of most value where the cane varieties are grown on a crop scale, because of the minor variations from place to place referred to above. Any information on such variations will add greatly to the value of the record; and a short statement of the environmental factors where any collection is placed should always be put in the foreground.

ROSENFELD's work is prefaced by an extremely interesting paper of some forty pages by C. E. CHARDON, upon recent changes in the varieties

grown in the different parts of Porto Rico, and afterwards by a reprint of one by F. S. EARLE on the chief features in the morphology of the cane plant which he has used in his taxonomic work.[1] Then, throughout the volume many of EARLE's descriptions have been inserted *in toto*, such cases being indicated by an asterisk. We imagine that somewhat over half the paper comes from ROSENFELD's pen, and perhaps it might have been better if this symposial character had been indicated in the title. But no one can tax the author with belittling former work in Porto Rico, for his generous tribute to EARLE's contribution leaves no doubt on this point. The present paper is in fact a second edition of that published by EARLE in 1921, greatly enlarged by additional matter and brought up to date.

CHARDON's paper is too important to be passed by with a mere remark. It is entitled "The Varietal Revolution in Porto Rico," and is primarily designed to emphasize the value to the industry in its commercial aspects of the work of studying the sugar cane itself. "A small island with all her available sugar lands taken up for many years has, contrary to all expectations, achieved a spectacular rise in her crops"; the amount of these crops is given in short tons of sugar during the past twelve years. During the last three an average of 625,000 tons has been reached, while in the previous ten the average was 440,000. This change was absolutely sudden, and appeared in an increase of 200,000 tons in 1925. The factors influencing the crop are considered in turn: these being acreage, rainfall, mosaic disease, and the varieties grown. The acreage under cane has been practically uniform for the past nine years. Before that, a somewhat lower figure prevailed in the records, and the rise in 1918 was owing to a revision of property ordered by the Government rather than to any actual increase in acreage. Since 1918, there has been little change, and the average for the past twelve years is slightly over 240,000 acres. Rainfall and crop curves are practically parallel from 1915 to 1925, showing the important influence of this factor on the crop. According to the amount of rain falling, the crop expectation for 1926 would have been over 480,000 tons because of good rains in the preceding year, and somewhat lower in 1927. In both years the yield of sugar was over 600,000 tons, so that the rainfall is not the factor concerned. The other two factors, variety and consequent resistance to mosaic, are interdependent; it was to fight mosaic that inferior new canes were introduced. The change of variety and consequently the influence of this factor have progressively increased from 1925 onwards; and the author thus justifies his use of the term "Revolution," because of the completeness and suddenness of the change.

Mosaic disease appeared in 1915, and spread so rapidly that, in 1918, it had invaded about three-quarters of the Porto Rican cane fields. The loss was estimated at half a million dollars in 1917 and two and a half in 1918, "in fact the whole north-eastern and western sections were on the verge of a complete breakdown." CHARDON prints a useful map showing the extent of mosaic infection, when at its highest in 1921. He relates that, in August, 1918, F. S. EARLE was commissioned by the United States Department of Agriculture to visit Porto Rico, "a most important event in the history of the island." EARLE at once set about testing some 171 varieties as to their resistance to mosaic, and quickly picked out Uba as immune, and POJ 36 and POJ 234 as highly resistant; at the same time pointing out the importance of a much more comprehensive knowledge of cane varieties than then existed,

[1] *I.S.J.*, 1922, pp. 236-239.

and especially as to their resistance to mosaic and root disease. A conscientious study of the large local collection of varieties was made, which resulted in the paper part of which is referred to above as reprinted here, and he strongly advocated the planting of Uba in the worst western tract. Within two years practically the whole of this area was under this cane; it was "Uba or nothing." During 1921-22, the tonnage of canes had dropped to 8·12 per acre on three estates; in 1923 it was 14·25, and in 1925 20·29. It was a case of emergency, and "planters did not stop to think of the trouble that was coming to them from the factory." Controversy soon arose, which was only finally settled by adopting a sliding scale of sucrose content. CHARDON continues his narrative: meantime the POJ's, which also came into prominence as mosaic resisting canes, "had become hopelessly mixed"; and ROSENFELD, who had recently arrived, was set to unravel the mixture because of his experience with these canes in Tucuman. At the present time there appears to be a revulsion in favour of better class canes, and BH 10 (12) and SC 12 (4) have been giving very satisfactory results; but both of these varieties, being susceptible to mosaic, are getting thoroughly infested in places. The rest of this paper deals somewhat fully with results obtained with these two cane varieties.

The really important theme of this volume of 330 pages lies in ROSENFELD's detailed descriptions of the different varieties; and, as nothing is said to the contrary, the various characters observed must be credited to the author's own observations, and not to the files in the office (of course with the exception of those prefixed by an asterisk, which signifies EARLE's work). Naturally, it is not possible to form an opinion of the accuracy of these observations, which have been made under certain conditions in Porto Rico; nor is this necessary. For the details have been recorded by an authority on canes who has had wide experience in various countries in the New World. A glance through the lists will convince anyone of the amount of labour that has been expended; and it now remains for workers in other countries to follow suit, and add their quotas in the founding of a comprehensive study of all the cane varieties which have made their appearance in the fields, as contrasted with such as have only been submitted to laboratory trials. The publication of such descriptions of varieties which have not as yet passed through their laboratory tests and been released and taken up by the planters, will not be of great value; nay, will rather add to the difficulty of the subject. ROSENFELD is to be congratulated on "blazing the trail" for those about to enter into this intricate but important business.

There are certain evidences of haste in the preparation for the press (which, by the way, is somewhat belated), that somewhat detract from the finished character of the work. The most curious that we have met with is one of the headings of EARLE's reprinted paper, where "Demonstrations" stands for "Deterioration" of varieties; It is a pity that in dealing with the origin of Uba (page 148), some attention has not been paid to those few workers who have studied canes of this class in their natural habitat in the east. We would again draw attention to the fact that it is recorded that the sugar cane was obtained from India by China about the fourth century A.D., as clearly pointed out again by DEERR in a recent number of this Journal.[1] There are three lines of study when dealing with such questions: Philological, historical and botanical. It is possible to make mistakes in philology, history may be false, but botanical evidence can be checked by anyone

[1] *I.S.J.*, 1927, p. 314.

interested. All of the so-called Japanese canes (there are none indigenous in Japan) are reported to have come from China, and China is known to have obtained its canes from India ; all of these cane varieties are said to be so similar that they might well be the same cane masquerading under different names. But it is very different in India. There is a very strong likeness among the members of the Pansahi class, but no one could make the mistake of confusing the Kahu of the Punjab with the Pansahi of Behar or the Merthi of the eastern portion of the United Provinces. The presence of different but stable varieties of the same class of cultivated or wild plants in any tract is the surest botanical evidence of their being indigenous in that tract.

The paper is illustrated by a number of plates which, as the author hopes they will do, adds attractiveness ; and some of these are finely coloured. The four plates detailing the colours of the different parts of the node are particularly praiseworthy, and are a new feature. But it is somewhat strange that the numbering of these plates is not by any means consecutive, and they are often far from the text which they illustrate. Then, the photograph of three "Japanese" canes on Plate XIX must be a good deal larger than lifesize ; they are represented as good-sized canes and not "extremely slender" as some of them are described.[1] But, although such blemishes rather strike one in the eye, they do not detract from the detailed characters is of the canes which have been so laboriously put together ; and we owe a great debt to the author for having gone to such pains in perfecting the descriptions of the canes of Porto Rico.

SUGAR CANE MOTH BORERS (DIATRAEA SPP.) IN BRITISH GUIANA. **H. E. Box.** *Bulletin of Entomological Research, Vol. XVI, Pt. 3, January* 1926.

Attention was drawn in a late number of the *I.S.J.*[2] to this interesting account of the ravages of moth borer in British Guiana ; and it was stated there that probably no other cane tract is blest with such an army of parasites upon this pest. Whether this is simply due to there being such a vast quantity of food for them or not, this fact is of great significance to almost all cane-growing countries ; surely here they will be able to find some form which will be able to adapt itself to their special conditions, and thus help them in their fight against this universal pest. The natural enemies of Diatraea in British Guiana detailed by Box compose a formidable list, and this is reprinted here for the benefit of all that it may concern.

Parasites.

A. Of the eggs.

CHALCIDOIDEA.

1. *Trichogramma minutum,* Riley.

2. *Prophanurus alecto,* Crawf.—Referred to as *Telenomus* sp. in early papers.

B. Of the larvae.

BRACONIDAE.

3. *Ipobracon grenadensis,* Ashm.—Probably the *Iphiaulax medianus,* Cam., of all other writers on *Diatraea* in British Guiana.

4. *Ipobracon puberulus,* Szep.—Now recorded for what is believed to be the first time as parasitic on *Diatraea* in British Guiana.

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[1] The promised "strictly alphabetical index" is not present and would certainly have been helpful

[2] August, 1927, p. 432.

5. *Ipobracon saccharalis*, Turn.—Recorded by TURNER (17).

6, 7, 8, 9. *Ipobracon* spp.—Four species not yet determined.

10. *Microdus diatraeae*, Turn.

11. *Microdus parvifasciatus*, Cam.—Referred to as *Cremnops parvifasciatus*, Cam., by MOORE, BODKIN and CLEARE.

12. *Microdus* sp.—Not yet determined.

ICHNEUMONIDAE.

13. *Mesostenoideus* sp.—Recorded by MOORE, BODKIN and CLEARE.

TACHINIDAE.

14. A Dexiine fly determined by the Imperial Bureau of Entomology as "*Stomatodexia* sp. very near to *S. diadema*, Wied." Specimens of this insect were sent to Mr. G. N. WOLCOTT in Porto Rico, who had them named by Mr. C. H. T. TOWNSEND as *Leskiopalpus flavipennis*, Wied.

C. Of the pupae.

CHALCIDIDAE.

15. *Heptasmicra curvilineata*, Cam.

Predators.

1. An ant, *Ectatomma quadridens*, F.—Recorded by CRAWLEY (7).
2. Larvae of Carabid beetles of the genus *Scarites*.
3. Larvae of an Elaterid beetle, probably *Monocrepidius* sp.
4. Larvae and adults of the Histerid beetle, *Lioderma quadridentatum*.
5. Larvae of a Stratiomyiid fly.—Recorded by MOORE (13).
6. Attid and other spiders.—Recorded by MOORE (13).

Vegetable Parasite.

A fungus *Cordyceps* (*Isaria*) *Barberi*.

The author remarks, anent burning, that when the fields are ready to be harvested there are large numbers of borers in the stubble, many of which are parasitized by Braconid wasps of the genera Ipobracon and Microdus in the pupal stage ; and large numbers of these pupae would finish their development in time to emerge between the cutting and milling of the cane. The tiny egg parasite *Trichogramma minutum*, which would deal with the earliest eggs of the moth borer, is also present in great numbers on the leaves. Burning destroys the whole of both classes, the latter because of its feeble flight.

Of the parasites enumerated, Trichogramma is considered to have the greatest influence in the biological control of Diatraea in British Guiana conditions. It occurs in the fields all the year round, and may reach, in prolonged dry weather, to an infestation of 75 per cent. of the borer eggs ; and probably at all times places nearly half of them out of action. Prophanurus is much less common, and probably not much more than 1 per cent. of all the egg clusters are attacked by it. Of the 10 Braconids, eight occur in Berbice, the scene of the author's labours, and he surmises that yet other species may be found in different parts of the cane belt. Of them, *Ipobracon grenadensis* and *Microdus diatraeae* are far the commonest and, on the average, 2 per cent. of dead hearts will contain one of them fixed to a grub. Their life cycle occupies about 17 days, 13 to 14 of which are spent in the cocoon stage ; these cocoons are in the form of blunt-ended cylinders, and average three-quarters of an inch in length, although varying greatly in size. The adults are sometimes, e.g., at the beginning of the rains, excessively abundant in the fields, feeding on the flowering spikes of Paspalum (grass), and flying round Cordia bushes. Another species, *I. puberulus*,

was found quite commonly in one locality, where it appeared to replace *I. grenadensis*.

These appear to be the chief insect parasites in the area worked over by the author; but at times a parasitic fungus, *Cordyceps* (*Isaria*) *Barberi* mummifies the grubs in their burrows; in the middle of the rainy season as many as 2 per cent. of all grubs are seen to be thus attacked.

The planters of British Guiana are not content to let the borer have all its own way, and for many years gangs of children have been employed in collecting these pests in the young fields, cutting out the dead hearts and removing the grubs. The rate of pay recommended by the author is a flat rate of 6d. per 100, in lieu of the varying rates usually paid (3d. to 1s.), as he found that this produced better results. These children have been trained to avoid damaging parasitized grubs, which they leave in the fields. The number of borers brought in by a gang of about 17 averages around 3000, but during heavy outbreaks as many as 12,000 to 15,000 have been collected each day. A Table gives the lists per month on two estates during 1922 and 1923, in each case totalling about one million per annum, more or less, presumably, according to the weather and the acreage available; dead hearts can only be cut where the fields are less than four months old. These gangs are also expert in collecting egg clusters of the borers, and at times a gang brings in as many as 12,000 (with perhaps an average of 30 eggs each); they are also trained not to interfere with the discoloured egg masses, which have been parasitized by Trichogramma. Where mistakes occur and such parasitized grubs or eggs are brought in, they are simply placed in the breeding apparatus, and the flies released in due course. The apparatus used on the estate for this purpose is of sufficient ingenuity to be very carefully considered by those engaged in this particular line of study.

The following description, printed by the author from one of his reports to his employers, is reproduced here in full, as it will be seen that it cannot usefully be abbreviated.

"A wooden building, 12 ft. × 8 ft. × 10 ft., with sloping corrugated-iron roof, is supported upon masonry pillars which rest in concrete cups containing an ant repellant (solignum or tar). The building has a few special features which allow of the capture of Braconid wasps, yet preventing the escape of moth-borers. There are two doors, the outer being solid and opaque, the inner on heavy springs being merely a frame covered with copper mosquito-mesh, allowing of ventilation and light when needed. There are two side windows, 2 ft. 2 in. square, also protected with wire mesh, and provided with adjustable roller-blinds of black Italian cloth on the outside, with 'lean-to's' to prevent the ingress of rain-water. At that end of the building which faces the morning sun is an opening, 1 ft. square, situated 6 ft. above the floor level; this opening is capable of being closed by means of a sliding shutter running in grooves on the outside of the building, but when opened allows of the insertion of a light frame cage, 2 ft. long, its ends very slightly smaller than the orifice in the wall of the insectary. One end of the cage (the other end is covered with mesh) can be pushed into the opening in the building, and is also grooved, and provided with its own sliding shutter, so that when pushed home it can be opened or closed independently. The interior of the building contains, besides the usual cages for the oviposition of captured or bred moths, a large cheese-cloth cage, 10 ft. × 4 ft. × 5 ft. in which are a number of shallow boxes to hold the cane-shoots brought in daily by the borer-gang and from which the parasites emerge. Large numbers

of *Diatraea* larvae leave the shoots and crawl about the inside of the insectary, pupating on the walls, etc., but the resulting moths will oviposit upon a number of cane leaves put into jars of water overnight, the eggs as they are obtained being used for rearing *Trichogramma.*

"When the outer door is closed, the blinds lowered, and the cage inserted with its shutter open, the interior of the building is in darkness until the shutter over the orifice in the wall is open, when the only source of illumination is through the cage, and it has been demonstrated that the Braconids fly to the cage within a few minutes after emergence. When the day's catch is complete, the end of the cage is closed by means of its shutter, and with its imprisoned contents is taken to the fields, where the parasites are to be released. The insectary is closed until further use by means of its independent shutter."

On an average, from 12 to 15 wasps which would otherwise have been destroyed by burning can be trapped daily and released into the cultivation.

At the end of this interesting paper, certain details are given of an attempted interchange, made by the author, of moth borer parasites between Porto Rico and British Guiana, two very different places. Porto Rico is also greatly interested in Diatraea, and has its own borer problems. Without going into details of these exchanges, which appear to have been attended with a certain amount of success, it is perhaps worth while remarking that this line of study is not quite so simple as might appear. Once the preliminary difficulties of the actual introduction have been overcome, the results cannot be forecasted, and seem to "lie in the lap of the gods." Perhaps no insect has received such careful study as Diatraea during the past hundred years, and we know a great deal about it; but this is not so with regard to its parasites. It is not sufficient to have followed out the life history of the latter in the laboratory, and to have noted the food requirements of the perfect insect. These flies and wasps are the freebooters of the canefields, and until we have a more intimate knowledge of the perils of their highways, we shall be unable to prophesy the amount of success that may reasonably be expected in any individual case. They are extraordinarily highly specialized, and the absence of any link in the chain of their particular wants may prevent their settling down and multiplying in their new environment. We want to know a great deal more about the natural history of each and every parasite of the moth borer; and the presence of lurking enemies, and of hyper-parasites, which infest *them* in their turn, is of course a matter of very great importance.

C. A. B.

Prof. E. C. BALY, at the Manchester Section of the Institute of Chemistry, recently stated in the course of a lecture[1] that the great mystery of the living leaf was that, in spite of the fact that a very large number of gram-calories had to be absorbed to bring about the reaction, yet the plant managed to effect it by means of visible light, and indeed, as far as one could ascertain, by light which lay within the yellow region of the spectrum. There was a photo-chemical reaction on the surface of the leaf, and it was believed that the large total quantity of energy necessary to activate the carbonic acid was supplied at the surface and then the process was completed by visible light. Photosynthesis took place in those cells which contained chloroplasts. There was strong evidence that the phenomenon of photo-synthesis of the plant was due to surface absorption. The formation of various complex carbohydrates, and indeed of simple carbohydrates, was largely, if not entirely governed, by the hydrogen-ion concentration. Probably, the preferential formation of sucrose in particular species of plants was due to the occurrence of a particular hydrogen-ion concentration which was maintained by a suitable buffer solution."

[1] *Journal and Proceedings of the Institute of Chemistry*, 1927, 3, 152-153.

Electric Wêlding for the Sugar Factory.[1]

By G. T. PEARSON,

Welding Engineer. St. Madeleine Sugar Factory, Trinidad.

Although the introduction of Electric Arc Welding into the St. Madeleine Co.'s factory in Trinidad did not establish a precedent in the sugar industry, the experience gained of the multifarious uses to which it can be put may not be without interest to others.

Within the last few years apparatus for arc welding has been highly perfected. Ours consists of a 16 h.p. motor coupled on single bedplate to a generator capable of delivering 250 amperes of current, complete with a long length of drum wound supply cable for connexion to the factory supply, of 220 volts D.C. The whole, including the switchboard panel, stabilizers, etc. is mounted on four rubber tyred wheels and can be manhandled on flat surfaces with ease, an important factor in cases of breakdown and emergency.

Briefly, electric arc welding is carried out in the following manner :—One pole of the welding generator is attached to the metal which is to be treated, while the other pole is connected to the operator's holder. Into the latter is placed the welding wire, usually termed the electrode. The current arcs from the electrode to the metal to be welded, or *vice versa*. In doing so, an intense heat is generated at the immediate point under the electrode causing both steel and electrode tip to melt at a uniform temperature, rapidly cooling to form a weld.

The first essay at welding was made in the locomotive shop, where a dozen or so engines were undergoing the usual out-of-crop repair. As is known, locomotives running on plantation tracks receive a pretty rough gruelling and the matter of reclaiming broken or worn parts is one of great importance. Some badly cracked side frames which in certain cases would have been impossible to patch were treated by arc welding, and at once the astonishing utility and economy of the process became apparent, as the cracks were untied with good sound metal in an incredibly short space of time. Then followed the adding of metal to oversize valve and piston crosshead pinholes and pins, these afterwards being machined to a standard size for every engine ; worn keyways were built back to their original depth ; leaking and defective steam and water pipe systems were welded at every joint ; worn faces of axle boxes had their wear taken up by welding thereon steel sheets. Two other undertakings representing the saving of a large sum of money are worth recording.

On one locomotive, the removal of a retainer valve casting from the boiler side disclosed that rust had eaten into the plate to an alarming extent, leaving only $\frac{1}{16}$th of an inch of metal underneath. This surface was built upon, and layers of metal added over the corroded area until a thickness of $\frac{5}{8}$ths of an inch was reached, through which new holes were drilled and threaded to hold the casting in place. It is no exaggeration to say that without welding this boiler must very shortly have ended its career of usefulness.

In the other instance, a new copper fire-box had been received from the manufacturers, but on attempting to fit it into an existing $2\frac{1}{2}$ in. thick steel foundation ring it was found to be undersize. Pieces of $\frac{1}{2}$ in. plate were thereupon cut and welded on to the inner faces of the ring and the fire-box fitted into it without any disturbance of the foundation ringholes. On the fire-box being placed in the boiler, further trouble was encountered due to the manhole rings not lining up, the fire-box ring being some 2 in. lower than that in the boiler plate. Pieces of correct thickness of plate were welded to the top

[1] From *Tropical Agriculture*, iv, 7, pp. 132-134 (here much abridged).

of the boiler ring and the ring bottom cut until correct alignment was obtained. The 2 in. thick manhole stiffening ring then being found too small, it became necessary to cut this through centres to extend, the extension gaps being filled up with weld metal quite easily and successfully.

The total cost of welding on these two undertakings did not exceed 55 dollars. Since in the first instance it is difficult to imagine how any other application but welding could have solved the problem, and in the second, nothing but the scrapping of a costly foundation ring and erection of a new boiler front could have met the case, no comparative cost can be estimated.

In the business of sugar planting and manufacture an astonishing diversity of mechanical equipment is employed, a fairly large proportion of which is manufactured from cast iron parts. Lest anyone fall into the error of imagining that arc welding is the cure for all machinery defects, it is necessary to mention that approximately only 40 per cent. of cast-iron welds are successfully carried out. The difficulty encountered in welding cast-iron arises from expansion and contraction of the local area heated by the arc, often causing new fractures, and the tendency of the weld to become hard and brittle when the casting has cooled, due to absorption of a large amount of free carbon from the casting. With facilities for preheating in a properly constructed furnace and slow annealing after carrying out the weld, the above mentioned proportion of successes could be considerably increased, but as yet, we have not made provision for this correct method of treatment.

In certain cases too, the Electric Arc is not nearly as adaptable as the Oxy-Acetylene flame—the spreading heat from the latter enabling the welding engineer to distribute the heat expansion stress over a much larger zone, thus keeping the casting at a weldable heat.

From the host of welding jobs undertaken prior to the commencement of the crop, mention may be made of the following : –

Construction of new pipe length and branches for Water Cooling Tower.
Treatment of a badly fractured Mill Bed.
Fractured Sugar Basket distance pieces.
Building up for re-machining Centrifugal Basket Shafts.
Filling up wrongly drilled holes.
Building up worn shafting of Scraper Plate, Cane Chopper Knife, Cane Rake Shafts, etc.
Fractured Cane Weigher Scale Beams.
Building up worn gear teeth.
Building up worn keyways in engines and motors.

Many repairs had necessarily to be executed hastily, but despite this the pleasing proportion of 95 per cent. of all welds undertaken has been successful in service. But unless properly acquainted with the properties of welding, engineers may fall in the habit of imagining that the "sticking a little bit" on to a job will produce a permanent and lasting repair. Actually, good welding can only be expected to follow careful preparation, and the total strength of say a ½ in. plate can never be obtained unless the weld is carried out to the total thickness of the ½ in. plate.

Mention should be made here of a highly efficient portable acetylene generator used in conjunction with our welding plant. This is a generator of unique design, since the carbide of calcium used to produce the acetylene gas is compressed into cakes — each cake producing a guaranteed gas yield. Together with cylinder oxygen, and the necessary cutting and welding torches provided with the outfit, we carry out all our metal cutting in thicknesses up to one inch plate, and over if required. Welding by this oxy-acetylene process is extremely valuable in thin sheet plate, heat from the

electric arc being usually too concentrated to weld on less than $\frac{1}{32}$ in. With this apparatus we can cut to within $\frac{1}{32}$ in. of accuracy and it is constantly being employed in the cutting of crusher roller point plates, circular pipe flanges, locomotive fire-box baffle plates, cane elevator plates, the opening of fractures in various structures for welding, the cutting of new trash plates, etc.

This is a great time and money saver, since on straight work, sixty feet of ½ in. steel plate can be cut in an hour, while on demolition work approximately 120 rivets per hour can be cleared from a structure. When one imagines the amount of labour that would be required to accomplish this task in the same time by old methods the great saving becomes immediately apparent. This generator has paid for itself over and over again.

In conclusion, it should be said that welding is an application of metallurgy and engineering, and its study should be so approached. Each job undertaken should be examined and treated on its individual merits, and where varieties of welding are met with, only a specialist—a thoroughly competent welding engineer—can obtain consistent and maximum results.

Calculation of Quantities and Steam Consumption for a Modern Beet Sugar Factory.

By WALLACE MONTGOMERY, Assoc M.I.Mech.E.

In view of the recently awakened interest regarding the manufacture of sugar from the beet in Louisiana and England, it might be well to study the conditions of manufacture. New methods and changes have been more freely applied in the manufacture of beet sugar than in that of sugar from the cane. The higher cost of raw materials, the shorter season for harvesting, and the necessity of making a high grade white sugar, have no doubt been responsible for these improvements.

Beets vary greatly in composition but usually contain about 80 per cent. water in which sucrose, and some non-sugars also, are dissolved, the percentage sucrose being approximately 15 per cent. to 18·5 per cent., forming 95 to 98·5 per cent. by weight of juice. The remaining 1·5 per cent. to 5 per cent. consists principally of fibre and insoluble matter. By extraction with water we obtain a solution containing the more diffusable substances of the true juice. This is a darkish grey liquid which rapidly darkens on exposure to the atmosphere. The composition of this diffusion juice is approximately as follows: Brix, 14·10; sugar, 11·60; and purity, 82·30?.

Assuming that we have a beet of 18·71 per cent. sugar and 81·00° purity, with a loss during the diffusion process of 0·14 per cent. sugar on beets, then the total sugar entering the factory in the juice is: Sugar in beet *minus* sugar lost in batteries, or, 18·71 — 0·14 = 18·57 per cent. on beets. From this figure and the purity of the juice we find the total solids to be $18{\cdot}57 \times \frac{100}{82{\cdot}30} = 22{\cdot}55$ per cent. on beets; and the non-sugars $22{\cdot}55 - 18{\cdot}57 = 3{\cdot}98$ per cent. on beets. Now with a juice containing 11·60 sucrose by actual analysis, and 18·57 per cent. sugar on beets, we can therefore determine the exact amount of juice thus: $\frac{18{\cdot}57}{11{\cdot}60} \times 100 = 160$ per cent. juice on beets. An actual percentage from the daily operating report (D.O.R.) showed 157 per cent. on beets in this case.

In the regular factory process, this juice (known as raw juice) is heated; and lime in the form of a water solution in a non-Steffen factory, or in the form of saccharate, in a Steffen factory, is added for the purpose of purifying and precipitating the impurities present. In order to carry our calculations through the same channels, we will now consider the milk-of-lime. Freshly burned lime is prepared in the form of a water solution of about 35° Brix (containing approximately 35° Brix) although this varies in different factories.

Carbon dioxide gas.—In the process of purifying the juices and after the addition of lime, carbon dioxide is added to the juice, forming calcium carbonate (lime-cake) which is removed in the filter-presses. Assume that we use 4·61 per cent. of lime on beets, to remove this we must add a certain quantity of carbon dioxide. From the equation $CaO + CO_2 = CaCO_3$, we find that $56 + 44 = 100$, that is, it will take 44 lbs. of CO_2 to precipitate 56 lbs. CaO. Therefore CO_2 gas necessary is: $4{\cdot}61 \times \frac{44}{56} = 3{\cdot}62$ per cent. CO_2 on beets.

Thin-juice.—The composition of the thin-juice after the addition of lime' and after heating, carbonating and filtering, will be as follows: Sugar from diffusion or raw juice = 18·57 per cent. on beets; sugar lost in presses = 0·08 per cent. on beets; total sugar on thin juice = 18·49 per cent. on beets; purity (analysis) = 85·90; total solids = $\frac{18{\cdot}49}{85{\cdot}90} \times 100 = 21{\cdot}52$ per cent. on beets; non-sugars = $21{\cdot}52 - 18{\cdot}49 = 3{\cdot}03$ per cent. on beets. Then total amount of thin-juice, with analysis of juice showing 10·91 per cent. sugar, $\frac{18{\cdot}49}{10{\cdot}91} = 168{\cdot}5$ per cent. on beets.

Lime-cake.—We know from our previous results that: Lime = 4·16 per cent. on beets; CO_2 gas = 3·62 per cent. on beets; and sugar = 0·08 per cent. on beets; the non-sugars = non-sugars in raw juice — non-sugars in thin-juice or $3{\cdot}98 - 3{\cdot}03 = 0{\cdot}95$ per cent. on beets. Therefore, the total of these figures = total solids or 8·81 per cent. on beets. This lime-cake has been found to consist of 60 per cent. moisture and 40 per cent. of solids. Then total wet cake = $\frac{8{\cdot}81}{40{\cdot}00} \times 100 = 22{\cdot}03$ per cent. on beets. This cake is washed to remove the sugar, the wash-water passing along with the juice. Approximately 1·73 lbs. of water are used per lb. of cake, so that wash-water = $22{\cdot}03 \times 1{\cdot}73 = 38{\cdot}11$ per cent. on beets.

Evaporation and thick-juice.—After the proper purification and filtration of the thin-juice, it is concentrated by evaporation in multiple effect evaporators, using exhaust steam to heat the first body, and the vapours from that body to heat the second and so on, the last body being connected to a condenser and vacuum pump causing vacuum on the bodies of the evaporator except the first which is under pressure. From analysis we find the concentrated juice to be in this case: Brix, 63·00; sugar, 54·20; purity, 85·90. From our previous results we know our thin-juice to have a Brix of 12·70, and to amount to 168·5 per cent. on beets.

Then thick-juice is: $168{\cdot}5 \times \frac{12{\cdot}7}{63} = 34{\cdot}68$ per cent. on beets. Therefore, we have an evaporation of: $168{\cdot}5 - 34{\cdot}68 = 133{\cdot}82$ per cent.

Raw sugar and first liquor.—The thick-juice from the evaporators goes usually direct to the melter where the "raw sugar" (that is, the second sugar), a grade of sugar not fit for marketing direct in the raw state due to its colour and low purity, is mixed with this juice forming what is called first liquor. We will first take the raw sugar. From analysis we find the purity to be 95·60, and assume a Brix of 97·0. We know that the total solids in the green syrup or molasses from the first sugar must be equal to the total solids from the molasses *plus* the total solids from the raw sugar, and if we let X = the non-sugars in raw sugar we have : Totals solids $= \dfrac{x \times 100}{100 - 95{\cdot}6} = 22{\cdot}72x.$

Total solids in molasses = 8·32 per cent. on beets ; and non-sugars in molasses = 3·65 per cent. on beets. Therefore, non-sugars = 4 + 3·65 ; total solids $= x + 3{\cdot}65 \left(\dfrac{100}{(100 - 73^*)}\right)$; total solids $= 3{\cdot}71x + 13{\cdot}5$. Hence $22{\cdot}72x + 8{\cdot}32 = 3{\cdot}71x + 13{\cdot}5$; $x = 0{\cdot}273$ per cent. on beets.

Then the composition of the raw sugar is as follows : Non-sugars = 0·273 per cent. ; total solids ($22{\cdot}72x$) = 6·200 per cent. ; sugar (6·20 — 0·273) = 5·927 per cent. on beets, and the quantity of wet sugar $\dfrac{5{\cdot}927}{97{\cdot}0} \times 100 = 6{\cdot}11$ per cent. on beets.

As the first liquor is the thick-juice *plus* melted raw sugar we have : 34·68 + 6·11 = 40·79 per cent. on beets. The first liquor is sulphured until the alkalinity has been reduced to approximately 0·015 grms. CaO per 100 c.c., after which it is heated and then filtered througn plate-and-frame presses. The clear resultant liquor is now boiled in pans under vacuum and concentrated to such a degree that the sugar crystallizes out. This mass of crystals and mother-liquor is known as white massecuite (or as white fillmass in America). It is spun in centrifugals, the crystals of sugar being washed with water. The mother-liquor is known as green syrup and the wash-water as wash-syrup. The wash is taken back into first pans, while the green is used for boiling the raw or second pans.

White pans or white massecuite.—By analyses we find the white pans to be Brix = 92·90 ; sugar = 79·70 ; and purity = 85·80. The weight of 1 cub. ft. of massecuite at 92·90 Brix = 93·45 lbs. ; cub. ft. of massecuite per ton of beets = 10·54. Then the quantity of massecuite is : $\dfrac{10{\cdot}54 \times 93{\cdot}45}{2000}$, = 49·25 per cent. on beets.

As was explained above, the wash syrup and first liquor are used to boli this first massecuite. Then total massecuite *minus* massecuite from first liquor equals massecuite from wash-syrup. Massecuite from thick-juice at 64·5 Brix : $\dfrac{48{\cdot}71 \times 64{\cdot}5}{92{\cdot}9} = 33{\cdot}8$ per cent. on beets ; 49·25 — 33·8 = 15·45 per cent. massecuite on beets from wash-syrup.

Wash-syrup.—From analysis we find wash to be ; Brix = 66·90 ; sugar = 54·00 ; and purity = 80·60. The quantity is then $15{\cdot}45 \times \dfrac{92{\cdot}9}{66{\cdot}9} =$ 21·37 per cent. on beets ; sugar = 21·37 × 0·54 = 11·57 per cent. on beets. total solids = 0·2137 × 66·9 = 14·33 per cent. on beets.

* Purity of the green syrup from analysis, 73·0.

Raw or second pans.—As was explained previously, the green syrup is reboiled and called raw massecuite or second pans. An analysis of second massecuite shows as follows : Brix = 95·10 ; sugar = 69·61 ; and purity = 73·20. Weight per cub. ft. at 95·10 Brix = 94·34 lbs. Cub. ft. per ton of beets = 3·41. Then the quantity of raw massecuite is : $\frac{3{\cdot}41 \times 94{\cdot}34}{2000} \times 100$ = 16·08 per cent. on beets.

Green syrup.—Green syrup is used to boil raw pans. An analysis of green is : Brix = 66·10 ; sugar = 48·30 ; and purity = 73·00. The quantity of green syrup is then $16{\cdot}08 \times \frac{95{\cdot}1}{66{\cdot}1} = 23{\cdot}15$ per cent. on beets ; and the composition is : Sugar 23·15 × 0·483 = 11·18 per cent. ; Solids 0·2315 × 66·1 = 15·30 per cent. on beets.

An excellent check on above calculation is made possible by the fact that all the non-sugars from the thin-juice and melted sugar are found in the green syrup. Non-sugars in green syrup = 3·81 + 0·273 = 4·083 per cent. on beets ; the total solids would be : $\frac{4{\cdot}083}{100 - 75} \times 100 = 15{\cdot}12$ per cent. on beets. At a Brix of 66·1 the quantity of green syrup is : $\frac{15{\cdot}12}{66{\cdot}10} \times 100 =$ 22·90 per cent. on beets. This gives a difference of 23·15 — 22·90 = 0·25 per cent. on beets, which is a very close check.

Molasses.—The molasses produced in this instance is of the following composition : Brix, 87·10 ; sugar, 49·20 ; and purity, 56·50.

From the formula for calculation of recovery we find that with an initial purity of 87·00 and a molasses purity of 56·50 we obtain 70·11 per cent. of the sugar contained. Molasses with total solids of 87·10 per cent. and sugar of 49·20 per cent. will contain : 87·10 — 49·20 = 37·90 per cent. non-sugars, or in each 100 lbs. of molasses there will be 37·90 lbs. of impurities.

Let us assume that the purity of the juice after purification is 87·00, and the loss in the presses (discussed previously) being 0·08 sugar per cent. on beets, then the sugar in our thin-juice is : 18·57 — 0·08 = 18·49 per cent. on beets ; total solids = $\frac{18{\cdot}49}{0{\cdot}87} \times 100 = 21{\cdot}25$ per cent. on beets ; non-sugars = 21·25 — 18·49 = 2·76 per cent. on beets. Therefore, molasses is, $\frac{2{\cdot}76}{37{\cdot}9} \times 100 = 7{\cdot}30$ per cent. on beets. Actual percentage from D.O.R. shows 9·55 per cent. on beets, which includes the washings from the raw sugar, usually 0·45 to 0·65 per cent. on beets. Using the D.O.R. figures of molasses per cent. on beets 9·55, sugar 49·2 per cent., and Brix 87·10, we would have a molasses of the following composition : Sugar = $7{\cdot}30 \times \frac{49{\cdot}2}{100} = 3{\cdot}59$ per cent. on beets ; solids = $7{\cdot}30 \times \frac{87{\cdot}1}{100} = 6{\cdot}36$ per cent. on beets ; non-sugars = 6·36 — 3·59 = 2·77 per cent. on beets.

Calculation of Quantities and Steam Consumption for a Beet Factory.

Given a definite amount of beets to slice, from the foregoing calculations we may check up factory operations and also determine the size of apparatus necessary to handle the resulting products. The following table shows at a glance the approximate quantities and analyses of all the products derived from the manufacture of sugar from the beet.

SUMMARY.

	Factory Quantities. Per cent. on Beets	Analysis Brix	Analysis Sugar	Analysis Purity	Per Cent. on Beets. Solids	Per Cent. on Beets. Sugar	Per Cent. on Beets. Non-Sugar
Beets	100·00	-	18·71	81·00	—	18·71	—
Cossettes (slices)	100·00	-	18·71	81·00	—	18·71	—
Water to displace juice	150·00	—	—	—	—	—	—
Water to fill cell	100·00	—	—	—	—	—	—
Total entering	350·00	—	—	—	—	—	—
Pulp and waste water leaving	193·00	—	—	—	—	—	—
Diffusion juice	157·00	14·10	11·60	82·30	22·50	18·57	3·93
CO_2 gas added	3·60	—	—	—	—	3·60	3·60
Juice leaving first carbona'n	224·60	—	—	—	31·51	—	—
Lime-cake	22·03		0·19	—	8·81	0·08	8·73
First press wash-water	38·10	—	—	—	—	—	—
Thin-juice to evaporators	168·50	12·70	10·91	85·90	21·52	18·49	3·03
Evaporator thick-juice	34·68	63·00	54·20	85·90	21·52	18·49	3·03
First liquor to pan	40·79	64·50	56·70	87·90	31·40	27·50	3·90
High-wash to pan	21·40	66·90	54·00	80·60	14·33	11·57	2·76
Straight pan massecuite	49·25	92·90	79·80	85·80	45·70	39·30	6·40
White sugar (dry)	18·20	—	—	—	—	—	—
Green syrup	23·15	66·10	48·20	73·00	15·30	11·08	4·22
Raw pan massecuite	16·08	95·10	69·50	73·20	15·29	11·16	4·13
Low-wash to molasses	—	—	—	58·30	—	—	—
Low green	—	—	—	55·00	—	—	—
Molasses	7·30	87·10	49·20	56·50	6·36	3·59	2·77
Raw sugar (wet)	6·11	97·00	92·70	95·60	6·20	5·92	0·273
Molasses and low wash	7·30	87·10	49·20	56·50	6·36	3·59	2·77

Now for the calculation of the steam consumption it is necessary to know the temperature and temperatures rise at each station. We will assume the following temperatures for the steam calculations :—

Place	Temperature Degrees Fahr.
Cossettes	90
Water entering battery	118
Pulp and water discharged	118
Diffusion juice entering measuring tanks	129
,, ,, leaving raw juice heater	185
,, ,, leaving first carbonation	176
Raw juice leaving first carbonation heater	203
,, ,, first carbonation presses	194
,, ,, first re-filter heater	203
,, ,, first re-filter presses	198
Juice leaving second carbonation	194
,, ,, second carbonation heater	203
Juice entering evaporators	189
Juice leaving	145
Juice entering blow-ups	140
Juice leaving blow-ups	212

COMPUTATIONS FOR STEAM CONSUMPTION.

Diffusion Battery 90°F. Cossettes 118°F. Diffusion Juice 129°F.

Quantities entering Cossettes.

Water to displace juice	150	per cent.	on beets
Water to fill cell	100	,,	,,
Total entering	350	,,	,,
Quantity leaving—			
Juice	157	,,	,,
Pulp and waste water	193	,,	,,
	350	,,	,,

Heat entering, B.T.U. above 32° per 100 lbs. Beets.

Cossettes 100 × (90 — 32) × 0·9 = 5,220 B.T.U.
250 × (118 — 32) = 21,500 ,,

26,720 ,,

Heat Leaving.

Juice 157 × (120 — 32) × 0·9 = 12,434 B.T.U.
Pulp and W.W. 193 × (118 — 32) = 16,598 ,,

29,032 ,,

Heat supplied for heating = 29,032 — 26,720 = 2,312
Assume 20 per cent. radiation 462

2,774

With steam at 9 lbs. gauge latent heat = 953·5 ; therefore, consumption

$$= \frac{2{\cdot}774}{953{\cdot}5} = 2{\cdot}90 \text{ per cent. on beets.}$$

Raw Juice Heater.

157 per cent. on beets. Temperature rise, 185 — 129 = 56° F. Steam

$$= \frac{157 \times 56 \times 0{\cdot}9}{953{\cdot}5} = 8{\cdot}28 \text{ per cent. on beets}$$

First Carbonation Heater.

224·6 per cent. on beets. Temperature rise, 203 — 176 = 27° F. Steam

$$= \frac{224{\cdot}6 \times 27 \times 0{\cdot}9}{953{\cdot}5} = 5{\cdot}27 \text{ per cent. on beets.}$$

Re-filter Heater.

168·5 per cent. on beets. Temperature rise, 203 — 194 = 9° F. Steam

$$= \frac{168{\cdot}5 \times 9 \times 0{\cdot}9}{953{\cdot}5} = 1{\cdot}72 \text{ per cent. on beets.}$$

Second Carbonation Heater.

168·5 per cent. on beets. Temperature rise, 2-3 — 194 = 9° F. Steam

$$= \frac{168{\cdot}5 \times 9 \times 0{\cdot}9}{953{\cdot}5} = 1{\cdot}72 \text{ per cent. on beets.}$$

Evaporators.

168·5 per cent. on beets. Pressure in first body will be about 3 lbs. Temperature, 223° F. Temperature rise in first body, 223 — 189 = 34° F.

$$\text{Steam} = \frac{168{\cdot}5 \times 34 \times 0{\cdot}9}{953{\cdot}5} = 5{\cdot}40 \text{ per cent. on beets.}$$

Evaporation.

168·5 — 34·68 = 133·82 per cent. on beets. Steam

$$= \frac{133\cdot82}{5\cdot40} \text{ or } 24\cdot78 \text{ per cent. on beets.}$$

First Liquor Blow-ups.

40·8 per cent. on beets. Temperature rise, 212 — 140 = 72°F. Steam at 100 lbs. pressure

$$\frac{40\cdot8 \times 72 \times 0\cdot8}{879} = 2\cdot67 \text{ per cent. on beets.}$$

Wash Syrup.

21·4 per cent. on beets. Temperature rise, 212 — 140 = 72° F.

$$\frac{21\cdot4 \times 72 \times 0\cdot9}{879} = 1\cdot56 \text{ per cent.}$$

Green Syrup.

23·2 per cent. on beets. Temperature rise, 212 — 140 = 72° F.

$$\frac{23\cdot2 \times 72 \times 0\cdot9}{879} = 1\cdot71 \text{ per cent. on beets.}$$

Straight Pans.

Syrup, 40·8 per cent. on beets; wash-water, 21·4 per cent. on beets; total, 62·2 per cent. on beets; massecuite straight 49·3; water evaporated = 12·9 per cent.

Steam at 60 lbs. gauge required to evaporate 1 lb. water at 25 in. Vacuum is 1·15 lbs.; therefore, steam used 12·9 × 1·15 = 14·84 per cent. on beets.

Raw Pans.

Massecuite per cent. on beets = 16·08; green syrup used at 62° Brix = 23·15; water evaporated = 7·07 per cent.; steam = 7·1 × 1·15 = 8·17 per cent. on beets.

SUMMARY.

Station	Exhaust Steam Per Cent. on Beets.		Live Steam Per Cent. on Beets.
Diffusion battery	2·90	..	
Raw juice heater	8·28	..	
First carbonation heater	5·27	..	
Re-filter heater	1·72	..	
Second carbonation heater	1·72	..	
Evaporators, evaporation	30·18	..	
First liquor blow-ups		..	2·67
Wash syrup ,,		..	1·56
Green syrup		..	1·71
Straight pans		..	14·84
Raw pans		..	8·17
Granulators		..	1·00
Radiation, etc.		..	5·00
Total	55·07	..	34·95

TOTAL STEAM CONSUMPTION 90·02 PER CENT.

The above is not from and at 212° F. but is sufficiently close for our purpose. The total steam consumption of 90·02 per cent. on beets is fairly close to the general run of factories, although local conditions govern considerably this figure.

Evaporation under pressure is attracting considerable attention at present and has been used with great success in Continental beet houses. This seems quite attractive, as beet manufacturers are dependent on outside fuel, not having a supply such as the cane industry has. Fuel in any form is expensive and any saving here amounts to quite a sum. There are great possibilities also in the use of thermo-compression as a means of greater steam economy. Operating a plant with the Steffen process in connexion increases the steam consumption considerably, bringing up total steam per cent. on beets to approximately 110 per cent.

The Relation of Regularity and Density of Sugar Beet to Yield per Acre.[1]

By J. HUNTER-SMITH, B Sc., and H. RHYS WILLIAMS, B.Sc.,
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The experiment to be described was made on a typical field of sugar beet at the Herts Institute in 1926. The soil shows considerable variation over the field and consists of veins of gravel, loam and clay loam which run across the rows. The ground was subsoiled, dunged and a complete dressing of artificials applied before seeding. Seed was sown on April 22nd at the rate of 20 lb. per acre on the flat; the rows were 22 in. apart; the crop yielded just under 12 tons of washed beet per acre.

For a perfect test of the matter under discussion it would be necessary to divide a whole area into yard-lengths of row, count the plants on every yard, and finally weigh the produce from every yard. This very big task was reduced by drawing "sample lengths" in an approved way. Counting was carried out before singling, after singling, and at harvest. The counts give a measure of the "plant population" of the crop much as, when a "census" is taken, the distribution of the population of the country is determined.

The Plants before Singling.

As sown, the plants stand very close and it was necessary to count them on sample lengths of one foot of row. For the whole area, the average number of plants per foot was twelve, *i.e.*, the average spacing was one plant to every inch. But the average thickness of the plant was by no means the same for different rows. Thus on one row there was an average of eight-and-a-half plants per foot, on another fourteen plants, the difference probably being brought about by two spouts of the drill distributing seeds at very different rates. Where, as in sugar beet, regularity of plant is very important, the need for an improved drill deserves attention.

More important than average differences between two rows was the irregularity of the plant from point to point of the field. On some one-foot lengths there were two seedling plants, on others twenty, on other six, and so on. By aggregating all sample foot-lengths containing the same number of plants we may perceive what proportion of the whole area carried plants at the rate of two per foot, or six per foot, or thirteen per foot, and so on. It will be realized that all the lengths with, say, seven plants per foot were not situated close together but scattered over the field.

The "make-up" of the area before singling was in round terms as follows:

[1] Abridged from the *Journal of the Ministry of Agriculture*, 1927, 34, No. 5, 448-453.

	Plants per ft.
On an aggregate of one-fifth of the area there were from	0 to 6
,, ,, ,, ,, ,,	7 to 10
,, ,, ,, ,, ,,	11 to 14
,, ,, ,, ,, ,,	15 to 20
,, ,, ,, ,, ,,	21 to 49

Thus a "plant" of beet, pronounced eminently satisfactory from the farmers' point of view, proved, on examination, to be extremely irregular. Observations suggest that beet crops in general are no less irregular.

After Singling and Horse Hoeing.

At this stage, the length of row sampled was 9 ft., and the figures to be given were based on 200 such samples. In no crop should the final regularity of the plants be greater than in sugar beet, for great care is exercised at all the stages, including singling.

For the whole area there was an average of 7·7 plants per 9 ft., *i.e.*, an average spacing of 14 in. between plant and plant. As before, two important kinds of irregularity were found. For one row of plants the average spacing between plant and plant was 12·8 in.; for another row it was 15·6 in., and so on. This difference must probably be set down to the difference in judgment of two men engaged in singling. It is significantly great, and suggests the need for precision in singling. Presenting the area in five roughly equal aggregates as before, it may be said that the following distances from plant to plant were about equally common over the whole area:—From 54 in. to 18 in.; 15½ in.; 13½ in.; 12 in.; from 11 to 8 in.

The singled crop was thus decidedly irregular. To decide how far horse hoeings were responsible for gaps and irregularities, separate counts would have to be made after each hoeing, and this will be done in future investigations. It is interesting to note that the "doubles" (two plants at one point) amounted to 10 per cent. of the total number of plants. This statistical result deserves special mention as more than ordinary care was taken in singling, and farmer visitors commented most favourably on the success attained in this respect. Apparently a much higher standard of efficiency could, with advantage, be aimed at.

At Harvest.

As the season advanced, the crop presented a very attractive appearance, although one could not but notice the spectacular display made by a number of roots which had run to seed. The counts, however, proved that appearances were deceptive as only 3 per cent. of the roots had bolted.

The number of roots actually lifted averaged 7·5 per 9 ft. length—a very small reduction on the number present after the last horse hoeings. At individual points on the field the number varied from 2 up to 11 per 9 ft. length. For simplicity we may group the number from 2 to 11 in pairs, and consider what proportion of the field carried 2 or 3 plants per 9 ft. lengths, what proportion 4 or 5, and so on; and, in addition, the average size of the beet and the rate of yield for these separate proportions of the whole area. The table following presents the facts.

On these figures, the average yield for the whole area is 14·6 tons and the average weight of a single beet is 1·65 lbs. The yield as determined by weighing 16 plots, each one-twentieth acre, straight off the field proved to be 16·4 tons per acre. The difference between the two yields is doubtless due in large measure to the fact that the roots from the "sample" lengths were partially cleaned before being weighed.

No serious attention can be paid to yields at the rate of 8·6 tons from 2 per cent. of the area and 16·1 tons from 10½ per cent. of the area, as these represent small proportions of the whole area. It may, however, be suggestive that the yield per acre rose rapidly up to a certain density of the plants on the ground, and thereafter very slowly. On this supposition, only 12 per cent. of the area, namely, that portion with from 2-5 plants per 9 ft. length, was substantially less productive than it should have been through lack of plants.

Number of plants per 9 ft. length.	Approximate distance from plant to plant. in.	Aggregated proportion of field. per cent.	Average weight of a root (lb.).	Equivalent yield per acre (tons).
2-3	43	2	2·6	8·6
4-5	24	10	2·1	11·5
6-7	16	28½	1·9	14·6
8-9	12½	49	1·5	15·1
10-11	10	10½	1·4	16·1

From the results obtained in this investigation there is one general inference which is justifiable. As the distance between plant and plant diminishes, the average weight of a single beet also grows less ; but the number of beets per acre naturally increases. As the figures show, there is a steady increase in rate of yield with lessening distance from plant to plant. This is the fact of immediate practical importance. It suggests that in this crop of beet—and possible in many others—a bigger yield might have been obtained by ensuring more plants per acre. With plants uniformly at 12½ in. apart over an acre, the yield would have been 15·1 tons instead of 14·6 tons. The difference—half a ton—is not to be despised in a valuable crop like sugar beet. Moreover, most growers would probably consider 12½ in. unduly far apart for beets. The figures suggest that with plants uniformly at 9 in. or even 10 in., a yet greater increase in yield might result.

Probably also, had a shorter length been used from which to take the samples, *i.e.*, less than 9 ft., it would have been found that the gaps and irregularities were greater than the numbers given suggest. It is broadly true that small and mid-sized roots have higher sugar percentage than the larger ones. To illustrate this point three samples of roots, 50 in each, were sorted out according to size and analysed with the following results. The analyses were kindly made by the Rothamsted Experimental Station.

Average Weight of Roots.	Percentage of Sugar.
3 lb.	18·0
2 lb.	18·7
1 lb.	19·1

Thus, it seems possible that the closer spacings may not only secure a heavier crop but also a higher percentage of sugar.

With rows 22 in. apart, a distance of 9 to 10 in. from plant to plant would probably be regarded as satisfactory by most growers. This investigation suggests, however, that in practice the desired 9 or 10 in. is considerably exceeded, with consequent reduction in yield. In considering the spacing of beet, and, indeed, of all field crops, it is not only important to think in terms of averages, but also in terms of the many short lengths of plant row by which a field is made up. This mode of thought is particularly necessary in trying to ascertain how seed-bed preparation, sowing, singling, and hoeing may be so governed as to populate an acre evenly with that number of roots which will ensure the maximum monetary return.

Bagasse Furnaces.[1]

By G. H. W. BARNHART.

A compilation of data published by the H.S.P.A. in 1925 indicates a range of grate area from one sq. ft. per 52·7 sq. ft. of boiler heating surface, to one per 200·0 with an average of one sq. ft. per 100 sq. ft. of heating surface. Combustion volume ranged from one cub. ft. per 3·125 sq. ft. of heating surface to one per 14·93, the average being one per 7·45. Standard requirements called for 4·5 sq. ft. of grate area and 60 cub. ft. of combustion volume per ton of cane ground per hour.

Tests reported in the 1919 Proceedings of the Hawaiian Sugar Planters' Association indicated that rating in Stirling boilers could not be reached when the grate area was less than one per 100 sq. ft. of heating surface ; that "the furnaces were too small for the amount of work required and the trash was carried through the setting when an endeavour was made to force the boilers." Since that time, however, one factory with ample draft has obtained practically 40 per cent. better than rating with one sq. ft. of grate area per 145 sq. ft. of heating surface, and one cub. ft. of combustion volume per 39 sq. ft. of heating surface. Other factories have also been reported as obtaining better than rating from their boiler installations.

Practically twenty years ago the Ginaca-Keech furnace was evolved to overcome inefficient combustion resulting in the furnaces of the old Dutch oven type. In this furnace, the vertical bridge wall forms a flat surface, preventing any effect of a reflective action of the relatively cool boiler shell or tubes upon the fire in the furnace. The arch at the top of the bridge wall assists in this action as well as bending the flames back in their path and giving them a more tumultuous motion. The space between this arch and the top of the furnace is kept at a minimum, acting in the nature of a throttle, and at the same time intimately mixing the gaseous products. The dead plates placed over the upper portion of the stepladder are to eliminate "tramp" air whcih would ordinarily creep in through the upper grates, which are generally imperfectly covered with bagasse and where there is little, if any, combustion.

The curtain wall over the middle of the stepladder grate is supposed to deflect air, entering with the bagasse and through the hand firing door, down into the products of combustion, and to prevent its being drawn along the top of the arch to exert its cooling effect on the boiler heating surface before it can mix with the hotter gases. Probably the most important duty of this suspended arch, as curtain wall, is to enable maintaining an incandescent arch which is essential to good combustion. Without this wall very small volumes of air projected along the top of the arch will keep it cool, and reduce the efficiency of combustion.

This type of furnace was used quite successfully with horizontal return tubular boilers, but with the installation of water tube boilers, with larger heating surfaces, it became inadequate. Two or even three of these units per boiler were satisfactory up to a certain horse-power in the boiler, but tended to limit both grate surface and combustion volume so that operation was not satisfactory in the large sizes.

A solution seemed to lie in the installation of the flat suspended roof, the so-called "flat arch," which has many advantages over the circular brick arch, among these being : (1) it is simple and easy of construction ; (2) there is no side thrust against the walls of the furnace, the entire weight being carried

[1] Extracted from Reports of the Hawaiian Sugar Technologists' Association, 1927.

by steel beams which, in turn, rest on the side walls ; (3) the tile work forming the lining of the roof can be replaced without tearing down the furnace, and (4) in most types any small or large portion of the tile can be replaced without disturbing the rest of the tile.

Two types of suspended arches are available : the single suspended and the double suspended.[1] In the former the blocks are supported by cast-iron block clips, which slide on the flange of a cast-iron hanger. One layer of blocks forms the fire arch and acts as the insulator for the supporting steel and iron members to protect them from being burnt out by the intense furnace heat. In this type it is possible to burn down only part of the suspended block, when the danger of the iron supporting structure sagging or burning away entirely arises. In the double suspended type the upper blocks support the service or fire arch and protect the iron and steel supporting

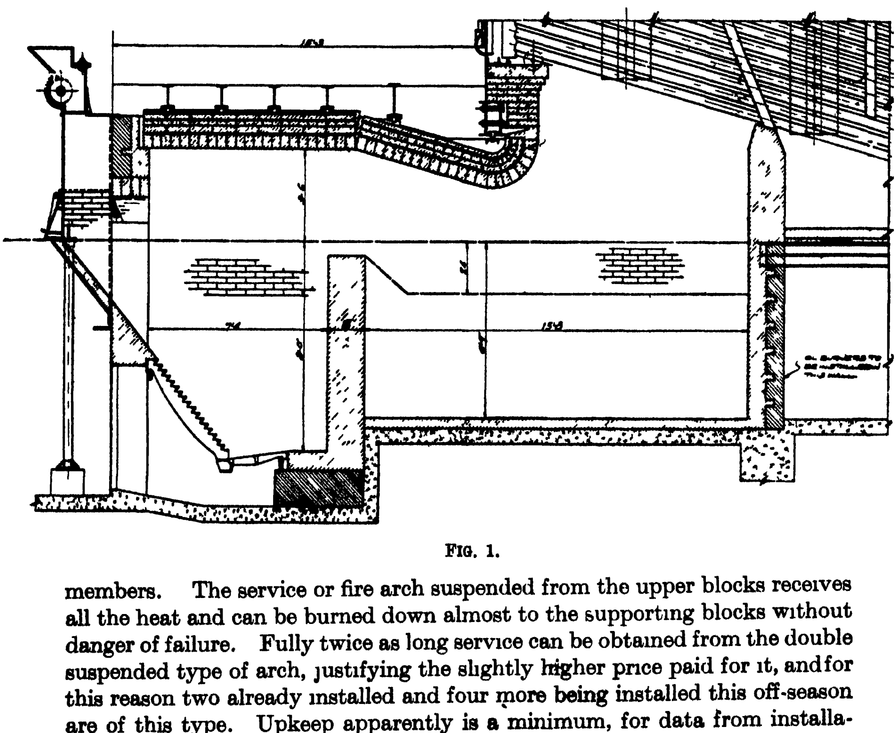

FIG. 1.

members. The service or fire arch suspended from the upper blocks receives all the heat and can be burned down almost to the supporting blocks without danger of failure. Fully twice as long service can be obtained from the double suspended type of arch, justifying the slightly higher price paid for it, and for this reason two already installed and four more being installed this off-season are of this type. Upkeep apparently is a minimum, for data from installations made in 1919 indicate that all of the 10 per cent. of spare tile, supplied with the installations, has not yet been used.

Fig. 1 indicates, in general, the layout of several installations, one already made and two to be made this off-season. One at Lihue, in connexion with a 478 horse-power water-tube boiler, has a furnace width inside of 8 ft. 5 in. but is fitted with the customary bagasse feeder inlet in the top of the furnace and has the objectionable curtain wall. The other two, being installed at Lahaina in connexion with 614 horse-power water tube boilers, each have an inside width of furnace of 12 ft. 5½ in.

Fig. 2 is the layout of the installation being made at Waipahu. The sloping bridge wall is being made at the suggestion of the boiler manufacturer

[1] See *I.S.J.*, 1925, 661-663.

who believes this change will greatly improve combustion. Loose bricks are shown on top of the bridge wall, the idea being that the distance from the top of the wall to the bottom of the arch should be varied after the boilers are placed in service to determine by trial just what distance is required to give the best results. Furnace width, inside, will be 12 ft. 5½ in.

It will be noted that the drop-nose effect has been included to assist in thoroughly mixing the gases on entering the combustion chamber. It also retains within the furnace proper a reservoir of hot gases which have their effect in drying the bagasse blanket. A third point is that the furnace cannot "see" the boiler heating surface, the latter not exercising their cooling effect until the gases have entered the combustion chamber. Since bagasse is a long flame fuel, requiring time and volume for complete combustion, the secondary combustion chamber has been supplied. This large volume also makes

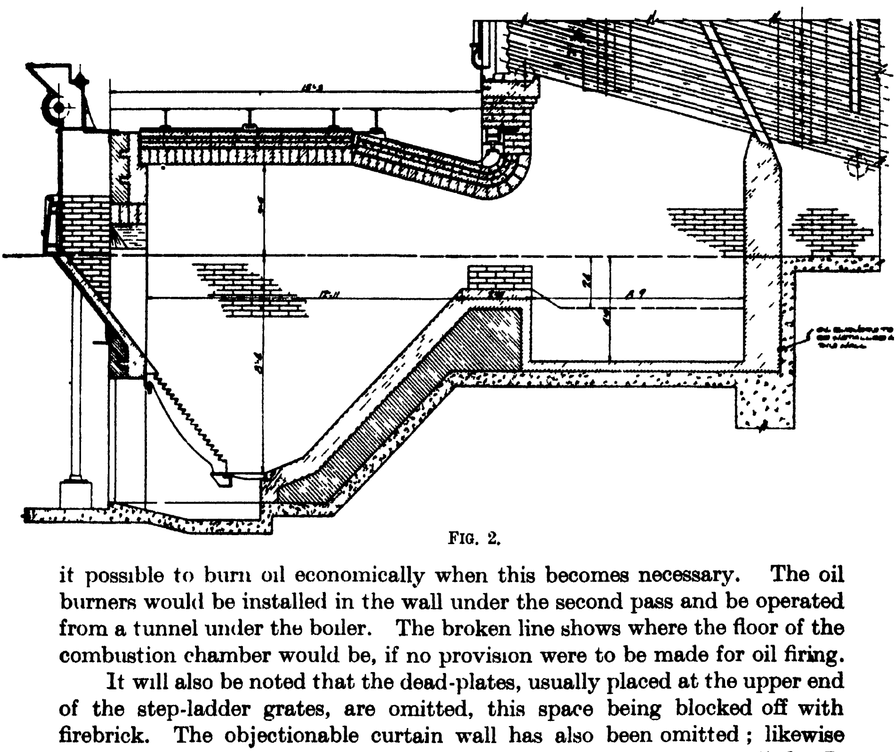

FIG. 2.

it possible to burn oil economically when this becomes necessary. The oil burners would be installed in the wall under the second pass and be operated from a tunnel under the boiler. The broken line shows where the floor of the combustion chamber would be, if no provision were to be made for oil firing.

It will also be noted that the dead-plates, usually placed at the upper end of the step-ladder grates, are omitted, this space being blocked off with firebrick. The objectionable curtain wall has also been omitted; likewise the bagasse feeder inlet in the top of the furnace is no longer supplied. It is thought that the major part of the carbonized particles of bagasse, which find their way up the stack, are the result of fine bagasse particles being drawn from the falling bagasse, or off the upper portion of the step-ladder, over the burning bagasse, through the boiler and up the stack, being volatilized and carbonized, but not completely consumed in this short passage. The two omissions mentioned have been made possible by a new departure which has been named the Ramsay (Patented) Bagasse Stoker after the originator. This utilizes an enlarged hand firing opening for spreading bagasse over the step-ladder grate. It is amply proportioned to prevent choking and the arrangement is such that an unusually large layer of bagasse is subject to the drying action of the furnace gases while moving downward to the grates.

O. R. OLSEN, chief engineer for Lihue Plantation Company, Limited, writes as follows: "With the installation of two cross-drum water-tube boilers this year it was decided to use the "Lip-tak" double suspension flat arch and to equip one boiler with the regulation step-ladder grate furnace, the other (478 h.p.) with a flat grate along the lines practised in Cuba. The flat grate measures 5 ft. 9½ in. by 7 ft. 4 in. and is now composed of a double row of grate bar elements with slots ¼ in. wide at the top. The flat grate furnace was installed with whatever material we had on hand, such as bottom grate bars and grate bar suspension bars, and was designed to make it a comparatively easy job to convert this furnace into the conventional step-ladder grate in the event the flat grate should prove unsuccessful. The firing doors were located on the fireroom floor level and the standard four fold doors were used in the ash pit, being brick-lined. The bagasse feeder was set 5 ft. in from the front of the setting in order to drop the bagasse on the centre of the flat grate, where it formed a cone. The distance from the top of grate to the main arch was 10 ft. 3 in. The top of the flat grate was 2 ft. 6 in. from the ash pit floor, the grate being 7 ft. 4 in. by 5 ft. 9½ in. The dimensions of the furnace proper were 8 ft. 3 in. from the inner face of front wall to the bridge wall, leaving a shelf 20 in. wide on the bridge wall end, and 10½ in. on the front end, while the width was 8 ft. 5 in. with a shelf 6½ in. wide on each side. After a trial of a few days we found the air openings in the grate bars were too wide, allowing too much bagasse to fall through, but we have just installed a new grate with ¼ in. openings which has remedied the above fault. Up to the present time the flat grate furnace has operated very satisfactorily and there has been no difficulty in operating the boiler above rating. We can maintain better steaming conditions with this furnace on account of its larger volume. It appears that both furnaces under the flat suspended arches are using about the same quantity. On account of the limited volume in the step-ladder grate, furnaces with brick arches one can load up with bagasse to a certain point only with good results, after which the furnace will choke. In the flat grate type, on the other hand, one can build up on the bagasse cone and continue to maintain a good, brisk fire on account of the larger volume available. Observation of this furnace in operation will remove from the minds of everyone the doubt or uncertainty of the practicability of the flat grate type of furnace for Hawaiian conditions."

HERBERT S. WALKER, with the Philippine Sugar Centrals Agency, writes as follows: "The flat grates work satisfactorily, but are difficult to clean. The best furnaces for burning our bagasse, which has moisture around 50 per cent., seem to be those with a moderate primary combustion space or firebox in the front of the bridge wall and a very large secondary combustion space between the bridge wall and the tubes. We have tried putting the bridge wall farther away with more flat grate area, but results were not so satisfactory, probably because more reflected heat is necessary to dry out the bagasse."

The following data relative to the installations under consideration are given :—

	Lihue. brick arch.	Lihue. flat arch.	Lihue. flat grate.	Waipahu. flat arch.	Pioneer, flat arch.
Sq. ft. of heating surface per sq. ft. of grate area	167 ..	128 ..	112 ..	137 ..	137
Sq. ft. of heating surface per cub. ft. of combustion volume	4·30..	2·68..	2·37..	2·34 ..	2·66
				2·10*..	1·87*
Number of grate units per boiler..	2 ..	2 ..	1 ..	3 ..	3

* Including additional volume in oil firing furnaces.

Bagasse Furnaces.

It will be noted that combustion volume relative to heating surface increases from left to right in the above. The Lihue brick arch installation, while showing considerably less grate area and combustion volume than the average, has produced 32½ per cent. above rating for intervals of 24 hours at a time. Likewise the present Waipahu installations with correspondingly reduced grate areas and combustion volumes have steamed consistently well above rating. Both of these installations, however, were very inefficient with oil firing when this became necessary to supply outside power over the week-end shutdown, or during emergencies, and the large secondary combustion chambers have been supplied to take care of this feature as well as to assist in better combustion of bagasse.

Publications Received.

Handbuch des Zuckerrübenbaues (Handbook of Sugar Beet Culture). By Dr. Theodor Roemer, Professor at Halle University, Berlin. (Paul Parey, Publisher, Berlin.) 8 + 366 pages; 73 Illustrations, some coloured. 1927. Price: 19 Goldmarks.

Since HERMANN BRIEM published his volume on "Practical Beet Culture" (Der praktische Rübenbau) more than 30 years ago, no comprehensive work treating in detail of the observations and results of the last three decades has come before the public interested. Prof. ROEMER now supplies beet sugar agriculture with a modern work that is greatly required. His book is a masterpiece in the systematic and exact presentation of the total knowledge of this subject which has accumulated to the present time. Different topics relating to the culture of the plant, such as fertilizing, the choice of seed strains, the technique of planting, cultivating and harvesting, plant diseases, the use of by-products for fodder and the like are dealt with exhaustively. All this is supported by complete bibliographic references, so that the student of agricultural economics is now furnished with the entire results of experiences of both pre-war and post-war periods. Particular attention is directed to the chapter on the physiology of the sugar beet, which summarizes our complete knowledge on the subject. Both beet grower and factory manager will find this work absolutely indispensable. Its price (19 marks) for a volume of this size and great value must be considered as very low.

Fifty Years of the Sugarbeet Breeding Station of Fr. Strube-Schlanstedy, Ltd., Prov. Saxony, Germany. (Charles W. de Rekowski, Detroit, Mich., U.S.A. Agent for U.S.A. and the United Kingdom.) 1927. Gratis.

This is an interesting account of the seed-producing activities of the famous firm of Strube-Schlanstedy, Ltd., at their Station at Schlanstedt, Saxony, Germany, where operations are carried on on a very large scale, over 5000 acres being farmed. A special type of seed which has been evolved by this firm is the "Compromise Z/e—E Type" which gives a higher tonnage than the present "Z" type of roots, but the same percentage of sugar. It is now an established constant type, producing from 850 to 1000 lbs. more sugar per acre than the "Z" type, which amount will still further be increased, as continuous selection progresses. Those interested should procure a copy of this booklet which gives much useful data on beet cultivation.

Mr. NORMAN RODGER (London) has in the press a new work by Dr. FRANCIS MAXWELL, the well known consulting engineer and sugar technologist, entitled "Economic Aspects of Cane Sugar Production." This volume presents in a nutshell numerous facts and figures compiled from personal experience and investigations made in the course of a world-wide tour of the principal cane sugar countries and deals with a number of comparative economic data not usually found in existing works relating to cane sugar. The book will be published about the middle of December. Further details can be gleaned from our advertising pages.

Brevities.

Mr. NOËL DEERR, who has for some years now been domiciled at Cawnpore, India, has been elected a Fellow of the Institute of Chemistry, London.

It is pointed out by the British Consul-General at Lourenco Marques that the post office of Portuguese East Africa is refusing to deliver letters, intended for Lourenco Marques but incorrectly addressed "Delagoa Bay."

A study by J. MIKOLASEK[1] over four campaigns in a beet factory refinery in Czecho-Slovakia led him to conclude that values for the dry substance as determined refractometrically are probably closest to the truth, as compared with other methods.

In a Cuban factory experiments on a small scale have been carried out on the purification of cane juice, using pepsin, which dissolves certain of the proteins.[2] It was stated that the increase in purity amounted to 1·0°, and that there was an increase in the rendement of sugar of 5 lbs. per ton of cane. About 1 lb. of the enzyme was added to the juice from about 50 tons of cane.[3]

In an article discussing the production of valuable by-products from Java molasses, Prof. Dr. D. VAN OS[4] reviews the possibility of utilizing this material for making alcohol, glycerin, acetic acid, oxalic and formic acids, etc., etc., but indicates that such manufactures are impracticable for Java. "For the sugar industry the solution lies in desaccharifying the molasses, which is a difficult problem, but worth looking into."

An account was recently given[5] of an apparatus for investigating the polarization of light by reflection, as presented by J. TOBIAS MAYER to the Gottingen Scientific Society on November 21st, 1812.[6] It consisted of two parallel plates, the back surfaces of which were blackened, the upper one receiving sunlight and reflecting it downwardly to the second, which could be rotated about a vertical axis. It was concluded by the author of this account that this was the apparatus now known as NORREMBERG's, though there is no record of this physicist having constructed his apparatus before 1842.

Referring to the determination of arsenic by methods such as the Marsh, as are used in the United Kingdom for the control of this impurity in sugar products and in materials used in its manufacture, Mr. A. A. KING[7] recently drew attention to the value of ultra-violet light in this connexion. Adsorption of the rays by the arsenic or mercury-arsenic stain makes this intensely black, so much so that stains which are quite indistinguishable in ordinary light stand out a startling black upon a fluorescent background. In this way it is claimed possible to estimate with certainty as minute an amount as 0·00000005 grm. As_2O_3, and to detect even smaller traces.

Tractors are of advantage in the beet field firstly for ploughing, but also for hauling harrows, "cultipackers," and drills, using the crawler tread, which travels over the soft loose surface without sinking in or cutting up. Then it is used in cultivation, and in American practice four, five or six of these operations are the rule. But it is in the harvesting period that the crawler type tractor shows to best advantage as it can go into the wettest field and haul the loaded beets to the highway. It can pull beet lifters with ease, or haul a line of three or four loaded wagons to the dump. Recently, it has been put to the loading of piled roots into trucks, this operation requiring the attachment of a steel frame carrying a basket scoop, which works with and is powered by the tractor, doing away with tedious piling and costly hand loading. This loading apparatus can be readily attached to or detached from the tractor.[8]

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[1] *Zeitsch. Zuckerind. Czechoslov.*, 1972, 52, 9-12. [2] *The Planter*, 1927, 79, 161-163.
[3] This process has been protected by H. SCHREIBER; see *I.S.J.*, 1926, 450.
[4] *Archief*, 1927, 35, No. 12. [5] *Die Naturwissenschaft*, May 28th, 1926.
[6] *Soc. reg. scien. Gottingen*, 1913, No. 9. [7] *Chemistry and Industry*, 1927, 55.
[8] *Facts about Sugar*, 1927, 22, No, 29. 703-704.

Review of Current Technical Literature.[1]

CLEANING EVAPORATOR TUBES BY CAUSTIC SODA SPRAYING. **N. E. Weight.** *Report of the Association of Hawaiian Sugar Technologists, Sixth Annual Meeting,* 1927, 122-124.

Cleaning evaporator tubes has always been a problem which involves much labour, time and expense, whether the cells be boiled out with soda, with soda ash followed by hydrochloric acid, or whether again mechanical or hand scrapers be used. During the 1926 crop in Hawaii, a sugar boiler tried spraying the tubes with a hot concentrated solution of soda ash, following this with boiling out with acid in the usual way. This worked fairly well. But highly satisfactory results are said to have been obtained by spraying with a hot concentrated solution of caustic soda, the tubes being so clean after two hours of spraying that the subsequent use of acid was unnecessary. Both method and apparatus employed are simple, the equipment consisting of a caustic soda tank having a capacity of 150 to 200 cub. ft., one small plunger pump, piping to the sprays, and return piping from the cells of the evaporator to the tank again. Garden sprays, made of white metal are used, the number of these used for each cell depending on the size of the cell. They are spaced out and are placed high enough over the tubes so that the caustic soda solution when pumped through them will be distributed over the whole of the calandria in the form of a fine rain. Then the caustic soda, kept hot by a small amount of steam in the calandria, is sprayed over the tubes during one to two hours, being washed over the tubes to the bottom of the cell, from which place it is drained back into the tank, and used over and over again. It is made up at a density of about 30°Bé. (say 55° Brix), and it can be used for several weeks before it is too weak for use. This method has been used at three factories in the Territory of Hawaii, and at one it has reduced the cost of cleaning the tubes from 6 to 2½ cents. per ton of sugar, giving clean evaporators without the necessity of opening the cells or removing the tubes. At one of the Hawaiian factories, a standard evaporator is cleaned in the following manner : Cells 3 and 4 are sprayed with hot caustic soda solution for about three hours, while at the same time a weak solution of caustic soda is boiled in cell 1 ; then all three cells are washed out ; some molasses is taken into cell 2, and water into the others; a carboy-and-a-half of muriatic acid is added to cell 4 and half-a-one to cell 3. All cells are boiled up ; steam is turned off after about an hour ; then compressed air is used to keep the solutions in motion for a few hours longer, after which the cells are washed out and closed. It is important that the sprinklers are placed at the proper height to spray the tubes and not the sides of the cells ; and that the cells are washed free from caustic soda before the introduction of the acid, which is of particular importance in cell 4, in which the thick scale may retain so much of the strong caustic soda solution that considerable acid is necessary to neutralize it. It is admitted that the results obtained with the spraying method of treatment will depend on the nature of the scale, but it is the most economical and efficient method known of using highly concentrated caustic soda, as there is very little loss of solution, and very little consumption of steam.

PRESENCE OF STARCH IN UBA CANE JUICE. (*A*) **E. Haddon,** *S.A.Sugar J.*, 10, No. 10, 629-631. (*B*) **P. de Sornay.** *Revue Agricole* (Mauritius), 1927, No. 32, 61-62.

(*A*) At the Incomati Estate (Portuguese East Africa) a massecuite which would not boil was encountered, a vacuum as high as 27 in., with a steam pressure in the coils of 20 lbs., being used. Presuming the difficulty was due to dirty coils, the pan was emptied, when the coils on examination through the sight glasses seemed to be coated with a slimy black deposit ; but as soon as steam was admitted it all disappeared and the coils became bright. To a small quantity of the syrup, acid and alcohol were added, which immediately produced a voluminous precipitate occupying about 20 per cent. of the total volume, this being assigned to a high percentage of

gums (xylan, etc.). On carrying on the ordinary routine work it was found that the syrup had a purity of 76 and a glucose ratio of 12, and was so viscous that it could be drawn into a string without breaking. As a remedy to the evil another field was immediately harvested, and the trouble more or less disappeared. But the precipitate was examined afterwards, and found to be mostly composed of dextrin, which of course indicates that starch had been present. On examining the different juices of the factory, starch was found in every one of them. Even when later the sucrose content of the cane was over 14 with a purity of 84, starch was still present, but in smaller quantities. Canes of 8 and 20 months old were split in two, and a dilute solution of iodine was poured over them. Canes 8 months old showed starch all through the whole length of the stalk; those 20 months old showed starch only at the top and bottom nodes, and more so at the bottom. To ascertain whether the soil had any influence in the formation of starch, canes of different varieties were examined, (they were all about one year old) with the following result :—

	Brix.	Sucrose Per Cent.	Glucose ratio.	Purity.	Starch.
Uba	21·24	18·47	1·6	87·1	much
Badilla	22·75	21·32	1·3	93·7	none
Striped Uba	19·23	16·98	1·9	88·2	little
D1135	19·44	17·72	2·6	91·1	traces at top
Q813	21·11	19·74	1·0	93·5	none

Starch being only found in the Uba cane shows that it is a peculiarity of this variety; and no mention has previously been made of such a high percentage of starch in canes. Dr. H. C. PRINSEN GEERLIGS states that: "Starch occurs in the chlorophyll-bearing cells of the leaves, around the bundles in the leaf-sheaths and around those of the top of the stem," but he adds that "in the adult joints little or no starch is present." Starch having been proved to be present in this syrup, the the question naturally arises regarding its presence in the sugar. Two grammes of different sugars were placed in a test tube, 5 c.c. of a 0·25 per cent. iodine solution were added, being examined after 15 minutes with the following results :—

CLASS OF SUGAR.	Colour of Sugar.	Colour of Solution.
Unrefined Beet sugar from Lisbon	White	Yellow.
White Cane sugar from the United T. Sugar Market	White	Yellow
Java	White	Yellow
Incomati (Sulphitation)	Light Blue	Purple Blue
Reynolds Bros. Limited (Sulphitation)	White	Light Purple
Melville (Sulphitation)	White	Light Purple
Tongaat Superfine (Bach)	Slight Blue Tint	Purple Blue
Beneva (Sulphitation)	White	Light Purple
Hulett's No. 1 Refined (Bonechar)	Very Slight Blue Tint	Yellow
Edgecombe Refined (Double Carbonation)	Slight Blue Tint	Yellow
Illovo Refined (Suchar)	White	Yellow

Starch being present in nearly all unrefined sugars of South and East Africa, implies that it forms part of the impurities of the Uba juice. Addition of manganese to the soil might improve the quality of the juice, very little of which is found here in the ashes of the cane, inferring that this element present is more or less in an unavailable form. Until the question is solved, and so as to minimize the troubles due to starchy canes, planters should test their canes prior to cutting; and millers should strain their juices as much as possible, and not use hot water for maceration.

(*B*) Mr. DE SORNAY summarizes the following later conclusion (privately communicated) at which Mr. HADDON has arrived :—Starch is formed in all Uba canes in acid soils; stalks growing on alkaline soils show no traces of starch; stalks containing no starch, after vegetating during three weeks in an acid solution of 0·5 grms. of sulphurous acid per litre, formed starch; manganese does not prevent the formation of starch, but increases the purity of the juices; and when acid soils are limed, the formation of starch in the canes is more or less prevented.

Review of Current Technical Literature.

Revised Directions for the Dye Test for the Approximate Determination of the Colloidal Matter in Sugars, etc. M. S. Badollet and H. S. Paine. *The Planter*, 1927, 79, No. 7, 121-123.

More extensive experience in the use of the dye test[1] has also indicated the desirability of certain additions to the original directions. The water-soluble basic dye night blue is used for preparing the standard dye solution; and 1 grm. of the powdered dye is dissolved in distilled water and diluted to 1 litre. No acid or alkali is added for adjusting the *pH* of the distilled water that is used in dissolving the dye. In order that all dye test values may be comparable, all liquors examined should first be adjusted to a constant *pH* value. This adjustment is necessary for accurate comparison of dye values, but presents certain difficulties in practice. In the original description[2] of the dye test, 6·0 was suggested as the standard *pH* value, particular reference being made at that time to the examination of raw sugar. However, in the case of raw cane juice, *pH* 6·0 is about the point where flocculation starts. Also most factories are equipped to make *pH* measurements only by a colorimetric method, and certain difficulties are encountered in making an accurate *pH* determination on raw cane juice colorimetrically. In view of this situation and the fact that the natural *pH* does not ordinarily vary greatly, the determination of the dye value of raw cane juice can be simplified by omitting the adjustment of the *pH*. While the resulting dye values will not be as accurate as those obtained after adjusting the juice to a constant *pH*, the relative error will not be great. When it is desired to calculate colloid elimination by comparing the dye values of the mixed dilute juice and the defecated juice, the dye value of the latter should be determined after adjusting the defecated juice to a constant *pH* typical of mixed dilute juice. The *pH* value 5·2 is believed to be fairly typical of mixed dilute juice, and may be selected as the standard *pH* to which defecated juice is to be adjusted in such cases. If comparison is to be made between the dye values of other raw sugar factory products and the dye values of raw and defecated juices as determined above, the *pH* of these other products should be adjusted to 5·2 before determining their dye values. But if it is desired merely to compare the dye values of these other products with each other and not with the dye values of raw and defecated juices, a higher *pH* value such as 6·0 may advantageously be selected as a standard. For refinery liquors it is suggested that 6·0 be selected as the standard *pH* of refinery liquors, at least when comparison is to be made between the dye values of the original and washed raw sugars and affination syrup or between these dye values and those of other refinery liquors or sugars. The use of 7·0 as the standard *pH* value would be suitable when comparison is to be made only between the dye values of liquors having a natural *pH* of approximately 7·0. However, the dye test should in no case be made on liquors having a *pH* of 7·5 or higher, since the dye night blue tends to change in basicity and electric charge at a higher range of *pH*. The indicator bromcresol purple is satisfactory for colorimetric *pH* determination, using a block comparator. When comparing dye values, the *pH* at which the dye value was determined should always be stated. Regarding the apparatus and accessories used, a microscope with a fine adjustment is now recommended. This fine adjustment should be operated by a micrometer head graduated in millimeters or other units so that it will produce a vertical movement of the body tube of approximately 0·100 mm. to 0·200 mm. for a complete rotation. A more concentrated beam of light can be focused on the colloid particles by placing a low power objective (16 mm.) in front of the vertical plane surface of the capillary tube of the cataphoresis cell. This objective, together with the slit, lens, and arc lamp, should be aligned and the slit adjusted so that a sharply focused beam of light enters the capillary and produces an illuminated path through the central portion of the circular field of vision of the microscope. The 16 mm. objective, when once properly aligned, can be cemented in place in the wooden block that holds the glass cataphoresis cell. *Dye test procedure.*—To be followed when testing raw sugars and washed raw sugars: Five grms. of the sugar is dissolved in 25 c.c. of distilled water, and the solution is filtered through a 100-mesh screen,

[1] *I.S.J.*, 1926, 23, 97, 137, 497. [2] *I.S.J.*, 1926, 97-98.

which is then washed with small quantities of water. The filtrate and washings should be combined and diluted to a volume of 100 c.c. in a 600 c.c. beaker. A raw sugar solution prepared with distilled water will generally have a *pH* value of about 6·0, and adjustment of *pH* is not usually required. If, however, the *pH* value is found to vary from 6·0 by more than 0·2 or 0·3, the *pH* of the solution should be adjusted to the value 6·0 in order that all raw sugars examined may be on a comparable basis so far as influence of *pH* is concerned. The *pH* of the raw sugar liquors may be adjusted by the addition of small amounts of 0·05 normal sodium hydroxide or hydrochloric acid and tested separately with an indicator solution in a block comparator. 10 c.c. of the standard dye solution is added to the 100 c.c. of sugar solution, which is then tested in the ultramicroscope. If the colloid particles move toward the positive electrode they still carry a negative charge, in which case the stopcocks are opened and the solution is drained into the original beaker, more dye solution is added, and, after mixing well, the sugar solution is retested in the cataphoresis cell. This process is repeated until the colloid flocs fail to move progressively toward either anode or cathode when current is applied at the electrodes. In refinery work the *pH* values of the samples should be adjusted to 6·0 before making the dye test except where, as already discussed, comparison may be made at 7·0 *pH*. It is advisable to wash a portion of each sample of raw sugar examined to 99 purity and to determine the dye value of the washed sugar as well as that of the original sugar. The purpose of this scheme is to ascertain the relation between the quantity of colloids eliminated by washing and the quantity remaining in the washed crystals. This step is important in view of affination of the raw sugar before filtration and subsequent treatment of the melt. It was found that raw sugars of good refining quality washed to 99 purity give a dye value of approximately 100 or less, whereas some raw sugars of poor refining quality when washed give dye values well over 100—sometimes as high as 200. A large part of the colloidal material of some raw sugars of poor quality remains in the crystals during the washing, causing the washed raw sugar to have a high dye value. Such washed raw sugar requires an increased quantity of filter-medium for a good filtration and possibly may not give clear sparkling liquors. It has been found that some raw sugars with dye values of approximately 300, for instance, have dye values as high as 180 after being washed to 99 purity. The greater part of the colloidal material of such sugars is in the crystals and not in the molasses film enveloping the crystals. When a large part of the colloidal material is present in the sugar crystals, a raw sugar such as that just mentioned (dye value 300) may yield a washed raw sugar of higher dye value (180) than that obtained from a raw sugar of much higher original dye value (400 or above). Assuming that the colloidal material is present in the latter primarily in the molasses film, the raw sugar with a dye value of 400 (or above) might yield a washed raw sugar with a dye value of approximately 100. The melt from this washed raw sugar would be of better refining quality than the melt from the washed raw sugar of dye value 180. Such abnormal sugars (unusual quantity of colloidal material present in the crystals) can be detected only by making dye tests on the washed raw sugar. Consequently the dye value should be determined on raw sugars both before and after washing to 99 purity.[1]

JUDGING THE QUALITY OF REFINED AND DIRECT CONSUMPTION SUGARS. **Harald Lundén.** *Centralblatt fur die Zuckerindustrie*, 1926, **34**, No. 40, 1017-1018.

Since in refined and direct consumption products, the content in non-sugar substances is very small, it is a difficult, if not impossible, proposition to value them on the basis of the usual analytical data, e.g. polarization, ash and reducing sugar contents. It would certainly be very useful to have some more definite means of judging such sugars, and of thus distinguishing between the various qualities, than is afforded by the present methods. Having this object in view, the author has made a special study of new modes of examination, using, for example, ultraviolet light, tasting their solutions, and examining the colours and flavours produced

[1] Directions are also given for application of the dye test to juices, massecuites, syrups, molasses, etc.

on heating.[1] He points out preliminarily that the appearance of various grades of white sugars in ordinary light does not lead very far. Thus some so-called "half-refined" sugar (a German grade) had a greenish tinge and a tolerably pleasant taste, yet washed crystals, having much the same appearance, had a very bad taste and smell. It was not possible to establish any parallelism between the apprearance of sugars in ordinary day-light and their quality in respect of flavour. But it is said to be possible to state something definite when the products are viewed by ultra-violet light, and to establish in this way a scale of "whiteness," giving very precise figures. Some results obtained by working in this direction have already been published,[2] and now the importance of operating with crystals that are not too small, and are mostly about the same size, is emphasized. Coming now to tasting tests, these are carried out with solutions of about 2 per cent., which are introduced into the mouth by means of a porcelain spoon (holding about 15 c.c.) and held there for some time. Attention is paid especially to after-taste impressions, which are strongly marked in the case of impure sugars, and further the degree of sweetness can be estimated as the average of the opinion of several persons. Next the behaviour of sugars on heating is considered, and this is an important test: Tubes, containing 2 grms. of sugar, are placed in holes in a metal block, which is heated in such a way that 30 min. elapses between 100 and 170°C., following which the sugar is dissolved in 2 c.c. of water, and the intensity of its colour and taste is examined. It has been found in such tests that different grades of sugar develop different colours. A "first-class refined," for example gives a straw-yellow, but washed crystals develop a dirty, reddish brown solution, the first containing the shades that go to make up caramel colour, but the latter the amethyst shades already referred to by the author in other of his papers.[3] Regarding the flavour of these solutions, that of the caramel is fairly tolerable, the taste of the caramel not being unpleasant; but development of the amethyst colour must be regarded as a bad sign, as it is always accompanied by a very repugnant flavour. It may further be useful to examine the intensity of the colour of these solutions by yellow light[4] when one will see very little of the caramel, but will acquire a relatively strong impression of the amethyst. Some of the results obtained by the author in attempting by the application of these new methods to assess the values of white sugars are here summarized :—

		—Taste—		After heating to 170°C.	
Class of Sugar	Ash Content	Sweetness	After-taste	Taste	Colour
Group I : First-grade Refined	0·001	1	None	Sweet and caramel-like	Straw-yellow
Group II : Second-grade Refined	0·002 to 0·003	1 to 0·95	Hardly detectable	Sweet and caramel-like but more empyreumatic	Darker yellow
Group III : "Half-refined"	0·005 to 0·008	0·9 to 0·85	Distinct	Sweet and salty	Brown
Group IV : Washed and decolorized raw beet sugar	0·02 and upwards	0·7 to 0·65	Repulsive	Hardly sweet	Dark-Brown

[1] This writer's work has been carried out with Continental grades of refined and direct consumption sugars, which represent some qualities that do not occur on our market. Although he has worked with beet sugars, it is possible that certain of his methods may be of some use in judging cane direct consumption sugars more precisely than is done at present, especially in respect of their appearance in ultra-violet light, and behaviour on heating.

[2] *I.S.J.*, 1925, 614. [3] *I.S.J.*, 1927, 225.

[4] By holding a WRATTEN photographic yellow light filter No. 15G. before the eyes.

DETERMINATION OF SUGAR IN THE BEET USING ALCOHOL EXTRACTION. **Alois Dolinek.** *Zeitsch. Zuckerind. Czecho.*, 1927, **51**, No. 42, 499-511. In spite of the fact that the alcohol extraction method is regarded as a standard one, it is subject in this writer's view to several sources of error, and cannot give results within 0·2 to 0·3 per cent. of the truth. This is due mainly to the long continued heating, and to the basic lead acetate, both of which effects cause changes in the rotation of the sucrose and also of the optically-active non-sugars. Chemists are advised to leave this method alone, the cold aqueous digestion process being far more accurate, quicker, and cheaper.—ADVANTAGES OF USING H.I.C. **H. A. Macgillavray and J. Deinema.** *Archief*, 1927, **35**, II, No. 34, 872-877. Using only bromthymol blue indicator in one of the Java factories for controlling juice, and syrup sulphitation, and gassing in the first case to about *pH* 7·1 and *pH* 6·7 in the latter, a much more satisfactory result was obtained than formerly with titration, and it was possible moreover to economize in the sulphur consumption. In boiling, the results were similarly satisfactory, the colour was better maintained, the viscosity was diminished, the formation of "glucose" decomposition products was avoided, and frothing during the boiling of the molasses massecuites entirely disappeared.—UTILIZATION OF DISTILLERY SLUDGE FOR MAKING PEN MANURE SYNTHETIC. **Victor M. Hinchy.** *Tropical Agriculture*, 1927, **4**, 129. Some preliminary experiments have indicated that a material which is regarded as promising as a synthetic pen manure can be produced by treating heaps of cane trash or bagasse with distillery sludge, and allowing fermentation to take place, the heaps being turned over at intervals.—FARM-MADE BONE SUPERPHOSPHATE. **N. D. Vyas.** *Agricultural Journal of India*, 1927, **22**, 180-185. Bone-meal (finely-ground), 100; flowers of sulphur, 25; and and sand, 100, are made into a heap, moistened with 20 to 25 per cent. of water, and a little inoculum of sulphur-oxidizing bacteria from a previous operation added when after about six or eight months 96 per cent. of the phosphoric acid will have been converted into an available form, making a valuable and cheap manure. An addition of 6 per cent. (of the weight of the heap) of powdered wood charcoal increases the rate of "solubilization" of phosphoric acid. Fertilizer made in this way is stated to have increased the yield of potatoes 42 per cent., whereas the figure for superphosphate under the same conditions was 35 per cent.—NEW UNIVERSAL INDICATOR. **Emil Bogen.** *Journal of the Franklin Institute*; *Chemical Trade Journal*, 1927, **81**, *No.* 2105, 314. Phenolphthalein 0·100 grm., methyl red 0·200 grm., dimethylaminoazo-benzine 0·300 grm., bromthymol blue 0 400 grm., thymol blue 0·500 grm., absolute alcohol 500 c.c. These indicators are dissolved in the alcohol; and tenth-normal sodium hydroxide is added to the resulting solution until it becomes yellow in colour. In order to determine the hydrogen-ion concentration of a solution, one drop of the universal indicator is added to one cub. cm. of the solution; a red indicates *pH* 2·0, orange *pH* 4·0, yellow *pH* 6·0, green *pH* 8·0, blue *pH* 10·0. These values are approximate; more exact values may be obtained by comparison with buffer solutions of known *pH* to which the universal indicator has been added. Differences as low as 0·2 of a *pH* unit may be distinguished.—SURFACE DETERMINATION APPARATUS. **H. Cassel.** *Die deutsche Zuckerindustrie*, 1927, **52**, *No.* 38, 1066-1067. An improved apparatus operating on the principle of Eotvos' capillary tube method is now on the market, being so modified as to give readily reproducible results.—JUDGING THE QUALITY OF JUICES BY THEIR ELECTRICAL CONDUCTIVITY. **P. Honig.** *Archief*, 1927, **35**, *II*, *No.* 28, 709-722. One would not expect there to be strict correlation between the ash as determined gravimetrically and electrically, seeing that the composition of the mineral matter and of the organic non-sugars vary. Rendement formulae based on ash contents will probably have a greater value if the conductivity ash is used, this enabling one better to take account of the properties of the inorganic and organic non-sugars than by incineration values. Conductivities of molasses are lowest in the case of sulphitation factories, intermediate with defecation, and highest with carbonation, which order is the same as was found for the non-sugars eliminated per 100 of juice.

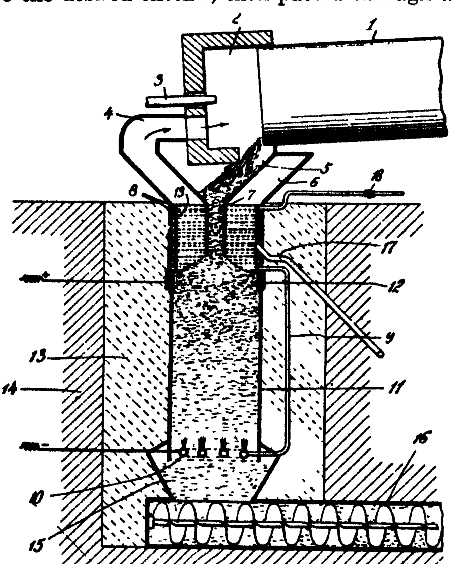
J. P. O.

Review of Recent Patents.[1]

UNITED STATES.

Production of Decolorizing Carbon. **L. Wickenden and S. A W. Okell** (assignors to the **Industrial Chemical Co.,** of New York). (*A*) 1,634,477 ; (*B*) 1,634,478. July 5th, 1927.

(*A*) This invention relates particularly to the manufacture of decolorizing carbon, and the process may comprise the preliminary calcination of the carbonized dissolved vegetable matter or other suitable material and subsequent treatment thereof as in a vertical electric furnace, where a mass or column of the material may be highly heated and simultaneously treated with steam, carbon dioxide, air or other desired treating gases. The feed of the material through the vertical or other furnace may be regulated so as to effect its activation to the desired extent, and the carbon is then cooled before being exposed to the air or other objectionable oxidizing medium. In the apparatus shown in the drawing, the calcining kiln 1 which may be of the rotary type may be mounted in any suitable way in connexion with the hood 2. The carbonized material fed into this kiln is preferably calcined dissolved vegetable material,[2] which is of such porous character as to be desirable because of its permeability in different directions. This or other suitable carbonized material is preferably repeatedly washed with water and acid, so as to remove mineral matter to the desired extent ; then passed through the rotary calcining kiln, where it is exposed to high temperature of 900 degrees or so Centigrade, and simultaneously acted on by carbon dioxide, air, steam or other gases. This calcining kiln may be heated in any suitable way as by the burner 3, through which a jet of oil or powdered coal fuel may be discharged to supply part or all of the heat of this calcining kiln. This treatment renders the carbon quite effective for some decolorizing purposes when it falls from the lower end of the kiln preferably into the feed funnel or hopper 5 connecting with the feed tube 7. The hot carbon descends this tube and fills the treating furnace, which may comprise the substantially vertical refractory furnace tube 11 of earthenware, fireclay or other suitable material, which preferably supported within the heat insulating packing 13 of asbestos, "Silocel" or other kieselguhr



material or the like, and an outer setting 14 of brickwork or other material may enclose and support the furnace and packing as indicated. The lower end of the furnace tube may communicate with the discharge hopper 15 leading into the discharge conveyor 16 of screw or other type, by which the treated material may be removed at the desired rate. This controls the movement of the carbon down through the treating furnace where it may remain twenty to sixty minutes more or less, depending on the treatment desired. It is desirable to heat the carbon in the treating furnace and electric heating means may be employed for this purpose such for instance as the heating electrode 12 arranged annularly or other wise adjacent the top of the furnace

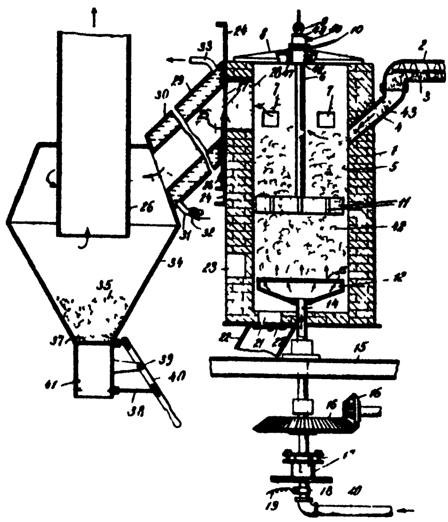
[1] Copies of specifications of patents with their drawings can be obtained on application to the following—*United Kingdom* : Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2 (price 1s. each). Abstracts of United Kingdom patents marked in our Review with a star (*) are reproduced from the *Illustrated Official Journal* (*Patents*), with the permission of the Controller of H.M. Stationery Office, London. Sometimes only the drawing or drawings are so reproduced. *United States* : Commissioner of Patents, Washington, D.C. (price 10 cents each). *France* : L'Imprimerie Nationale, 87, rue Vieille, du Temple, Paris. *Germany* : Patentamt, Berlin, Germany.

[2] Such as described in the Statham Patent 1,146,363, of July 13, 1925.

and co-operating with another suitable electrode at the bottom, which if desired may be the treating and injecting nozzles 10 arranged in spiral or ring form near the bottom of the furnace 2. These nozzles which may have a series of holes or slots for the discharge of the treating gases, such as steam, carbon dioxide, air, or other gases, or mixtures thereof, may be in the electric heating circuit and be supplied with the treating gases in any way as through the injecting pipe 9. This injecting pipe may advantageously include a preheating coil or portion 8 arranged adjacent the top of the treating furnace within the casing 6 and faced or protected by the fireclay lining 19 for example, and the treating gases which may be supplied in regulated amounts past the valve 18, may be highly heated as they flow through this preheating coil by the heat of the adjacent carbon and also by the combustion of the carbon monoxide and hydrogen issuing at the top of the furnace which may be burned in connexion with additional supplies of air or gases for combustion from any number of suitable pipes such as 17. The upper end of this casing 6 may communicate with the heat flue 4, so that these hot gases may be discharged into the calcining kiln to heat the material therein, and also act as treating gases thereon as previously described. Under operating conditions the carbon from the calcining kiln may have a decolorizing value of about 300 units or so on the standard kerosene red basis ; and this carbon may remain in the vertical treating furnace for about a half hour where the treating gases such as steam, air, carbon dioxide or the like can effectively act on this highly heated carbon at temperatures of 900 to 1000°C. or so. In this way the decolorizing value of the carbon may be raised to 700 units or more on this kerosene red scale and a carbon secured which is much more desirable for sugar clarifying purposes than vegetable decolorizing carbons heretofore available. For sugar clarifying or other carbons where sulphide or other impurities are undesirable, steam and air may be advantageously injected without admixture of combustion gases which usually contain sulphides.

(*B*) This process may comprise the treatment of calcined or carbonized dissolved vegetable material as in a vertical electric furnace where a mass of it may be highly heated and simultaneously treated with strong jets or currents of steam, carbon dioxide, air or mixtures thereof, or of other desired treating gases. The hot granular carbonaceous material may thus be activated to a considerable extent and also stirred and carried up sufficiently by the treating gases so as to be kept in a state of suspension in the furnace and thoroughly agitated. This seems to cause sufficient abrasive contact or other action to separate the more friable outer portions of the carbon particles which are the most valuable and active decolorizing material, and are considerably lighter than the relatively unchanged central portions of the particles. These are, carried up more readily by the ascending currents or jets of treating gas and may be thereby carried out of the furnace chamber to a suitable centrifugal or other separator so that the smaller more activated particles of the carbonaceous material may thus be continually separated and recovered while fresh untreated carbon may be fed to the furnace. If desired, however, the granular carbon may be heated and agitated in any suitable way, and gaseous currents may be produced by any suitable means so as to carry up or separate these finer or lighter activated particles which can be removed from the furnace. Where the lower electrode for heating the furnace is formed with the injecting openings or blast nozzles through which the treating gases are injected, it is usually desirable to have at least the lower electrode move or rotate in the furnace, since in this way the carbonaceous material is more uniformly heated and treated, and localized packing of the material correspondingly prevented. In the apparatus in the drawing, the electric furnace 1 may be formed of brickwork to provide a furnace chamber, preferably substantially vertical and may have an inside dimension or diameter of about 20 ft. throughout the lower portion 5 adjacent the heating electrodes. A tube 4 may be carried through the side of the furnace to feed in the carbonaceous material 43 such as uniformly sized, finely granular carbon of porous character, formed by calcining at high temperature, preferably in the presence of carbon dioxide, the carbonized dissolved vegetable matter contained for instance in the water soda liquors formed when paper pulp is made by the caustic soda process, or in the waste sulphite liquors from the sulphite wood pulp process

may in some cases be used as the source of this granular carbonized material. This material may be fed in hot condition by the screw conveyor 3 through the casing 2 communicating with the feed tube so as to be fed into the furnace without substantial or undesirable leakage of air into the same. The upper electrode 11 may comprise a series of narrow radially projecting arms so as to give ample contact with the carbon and yet not interfere unduly, especially at the outside of the furnace chamber, with the upward gas currents, and may be made of relatively infusible resistant metal connected by the stem 6 with a removable cover 8, for example, so that the whole may be lifted out of the furnace by the ring 9 and attached cable shown, which may be connected to a suitable counterpoise. The collar 49 adjustably secured to the rod 6 as by set screw 50 makes it possible to adjust the regular working height of this upper electrode. The heating current may be supplied to this electrode by the lead 10 for example; and this upper electrode may be insulated from the cover 8 by interposing a suitable insulating bushing 48 between the stem 6 and the hub 47 of the cover. The co-operating lower electrode may be arranged in any desired way adjacent the lower portion of the furnace chamber and may, if desired, be formed with nozzle openings



so as to inject into the furnace chamber the steam for other treating or separating gases which may also be used to activate the highly heated carbon. For this purpose the hollow electrode 12 may be formed with a series of nozzle openings 13 in its upper surface or portion and may be connected with the hollow stem 14 which is advantageously rotated so as to rotate this blast electrode within the furnace and promote the uniform agitation of the charge. For this purpose the stem 14 may be mounted in suitable bearings on supports such as 15, for instance, including the stuffing box 17, and may be rotated by the connected gearing 16 at the desired rate of four to ten revolutions per minute, more or less. The injecting pipe 20 may be connected to the stuffing box 17 and the electric current may be supplied to this electrode as through the grounded lead 19 and connected collar 18. The furnace may be provided at various points around its lower circumference with suitable cleanout openings or doors such as 21 and 23 and the slide 22 and shute 22^1 may be arranged at each lower opening 21.

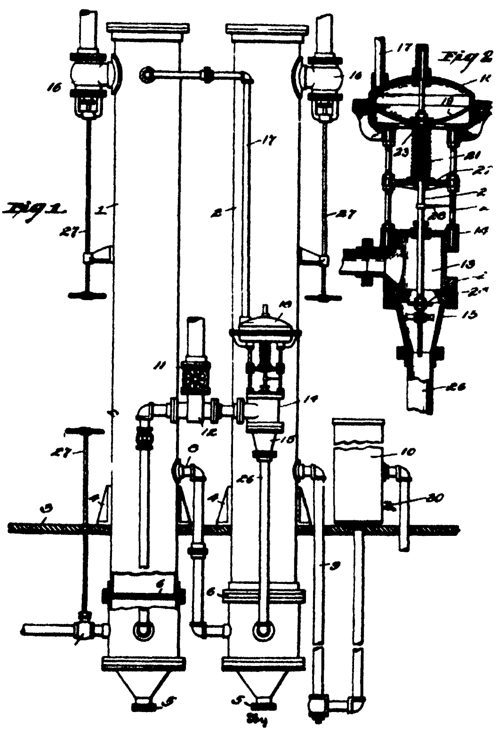
Also the furnace may have suitable peep holes through which small amounts of air may sometimes be admitted such as 7 in various parts, particularly in the upper part of the furnace adjacent the discharge opening 28 which is preferably on the opposite side from the feed tube 4 and may communicate with a depending conduit or passage 29 leading into a suitable separator, such as the cyclone or centrfugal separator 34. This separator may comprise the central discharge flue 26 through which the gases may be discharged or delivered into any desired apparatus such as a suitable compressing or pumping device in some cases so that more or less of these gases may be supplied preferably in hot condition to the injecting pipe 20 for use in the furnace, if desired. The lower part of the separating chamber may be provided with an air lock discharge device having the alternately opening discharge doors 37, 38 moved in opposite direction as by the lever or handle 40 pivoted about the point 39 so as to alternately open and shut these doors at the top and bottom of the discharge chamber 41. It is quite desirable to considerably cool the treated carbon from the furnace and for this purpose the passage 29 may in some cases be 5 to 25 ft. in length more or less, and provided with cooling means such as air currents or the cooling jacket 30 sur-

rounding the passage and supplied with cooling air or steam or with cooling liquid through the inlet pipe 31 having the valve 32 while the somewhat heated water or other liquid may be discharged through the pipe 33. In some cases also it is desirable to adjust the height and extent of the effective discharge opening from the inner wall of the furnace through which the treated carbon particles pass; and for this purpose a regulating valve or damper 24 may be used sliding in a box compartment between the furnace and discharge passage 29 while a co-operating cut-off valve 25 may be secured in position on this regulating valve as by the bolts 26 arranged in suitable slots in the regulating or cut-off valves. In this way the effective discharge opening 27 from the furnace may be adjusted in vertical width and also may be differently positioned so that the treated carbon particles may be withdrawn at a higher or lower point in the furnace chamber and the proportion and character of the discharged particles thereby regulated. Under normal operating conditions the top of the furnace charge is preferably maintained a few inches or so above the top electrode, by regulation of the feed of carbon to the furnace. The carbon particles which are carried or shot up from this agitated mass are naturally carried upward at different velocities, the lighter particles moving fastest as they leave the main mass and also being more influenced by the rising gas currents in the upper part of the furnace. The lighter more activated particles whenever they are shot up from the charge reach considerably higher levels in the furnace and the vertical adjustment of the effective discharge opening can thus make considerable differences in the recovered carbon. In starting the furnace the granular carbon may be brought up the to the desired high heat by the electric current between electrodes and this preliminary heating may be effected, if desired, before treating gases are turned on or fully injected into the furnace. Where no gases are used at first the carbon particles of course are in much closer contact with each other and the heating current under these conditions often becomes three to six times as great as the regular working current passing between the electrodes when the steam and other injecting gases are injected normally through the rotary hollow blast electrode at pressures of one to four pounds per square inch more or less. For this reason it is sometimes desirable to raise the upper electrode several inches or more when the carbon is first substantially heated; then the electrode can be lowered when the gas injection is gradually started. For a two foot diameter furnace the regular working current may be 50 to 100 amperes or so at about 220 volts, and this electric heating should be sufficient in connexion with the other heat generated to raise the carbon at least in the active zone of the furnace to temperatures of 900 to 1000°C. more or less. In some cases steam alone may be used as the treating and separating gas and may be injected under sufficient pressure to carry up the carbon particles in a boiling agitated mass, the lighter particles at least being projected considerable above the upper electrode 11 and the steam pressure causing such violent agitation in the furnace as to separate perhaps in connexion with the chemical action taking place in this mass of porous carbon, the outer lighter more friable portions of relatively activated carbon which have a higher decolorizing value and lighter specific gravity. These smaller and more valuable carbon particles are thus so much lighter as to be carried up by the jets or currents of treating gases and finally carried out of the furnace chamber through the discharge opening 27 so that they pass into the separator after being preliminarily cooled, preferably to such a point that undesirable combustion can no longer take place at least when they are removed from the separator. Where steam is used in the injected treating gases a desirable chemical converting action takes place in the carbon since the hydrochloric acid which is usually driven off from the small percentage of chlorides present in the acid washed carbon particles 42 in the furnace can usually recombine with the small proportion of cooled alkali in the treated carbon 35 in the separator so that the proportion of free alkali is greatly reduced in the final decolorizing carbon which is of considerable importance, especially in the treatment of sugar solutions. This automatic gravity or air flotation separation of the carbon by the treating gases in the electric furnace is so highly effective because of the decided difference in size of the carbon particles caused by this violent agitation and treatment of the carbon. This air separated activated decolorizing carbon also has considerably less specific

gravity than the carbon feed to the treating furnace, tests showing 1·7 to 1·8 specific gravity of the air separated treated carbon as compared to 2·2 to 2·4 specific gravity for the porous calcined dissolved vegetable carbon fed to the furnace. The operation of the furnace also seems to effect a separation of the ash constituents of the carbon, which, to a very considerable extent fuse together so as to form at the bottom of the furnace porous clinker masses which, at the high temperature maintained, pick up and incorporate any smaller ash particles which touch them during the agitation of the furnace charge. This activated carbon has very high decolorizing value for sugar and similar material.

Carbonating Apparatus. **Herbert N. Kilby, of Cleveland, Ohio, U.S.A. 1,627,439. May 3rd, 1927.**

Gas coming from the kilns now used in sugar plants never reaches a purity exceeding 40 per cent. of CO_2, the remainder being waste gas as it does not combine with the limed juices and serves no active part in the carbonating process. An object of this invention is to provide an apparatus which is composed of a few parts so arranged that the carbonation of sugar juice will be effectively and rapidly performed. Referring to the drawings, 1 and 2 designate carbonating vessels supported partially above and partially below the floor 3 by brackets 4. The lower ends of the tubes 1 and 2 are tapered and are provided with normally closed outlets 5 through which deposits of heavy material may be drawn off. Each of the tubes is provided with a perforated partition plate 6 adjacent the bottom thereof, which serves to break up the gas and thoroughly co-mingle the gas and juice. The juice which is admitted below the partition plate 6 of the tube 1 by means of a valve 7 rises to the level of the juice outlet port 8 and passes down into the lower portion of the second tube. From the second tube the juice passes through the pipe line 9 into the bottom of the overflow box 10 and then to the filter-press pumps (not shown). Commercial carbonic acid gas enters through the main gas valve 11 into a T connexion 12 and passes from the T connexion to the chamber 13 of the regulating valve 14, hereinafter to be described, and through the valve 15 to the lower portion of the first tube 2. Each tube is further provided with a valve 16 controlling the passage of waste gas from the tubes to the roof. A pipe line 17 connected to the upper portion of the tube 1 enters the chamber 18 above the diaphragm 19 of the valve 14 to cause the diaphragm to be subjected to the pressure of the waste gas. To the centre of the diaphragm is connected a valve stem 20 which is normally held in its uppermost position by the expansion spring 21 having its opposite ends in engagement with the adjustable support 22 and the plate 23 on the lower side of the diaphragm 19. The disc 24 is mounted on the valve stem 20 just below the chamber 13 and partially closes the conical opening 25 in the bottom of said chamber. The diameter of the disc 24



is less than the smallest diameter of the opening 25 in order that the valve 14 may be partly open at all times. The lower end of the valve 14 is connected by a pipe line 26 to the lower portion of the second tube. It is to be noted that extensions 27 are provided from all the valves so that they may be conveniently operated from the floor 3. The pointer 28 rigidly secured to the valve stem 20 travels over the scale 29 to indicate the quality of the gas entering the apparatus at all times and a small faucet 30 is attached to the overflow box so that samples of the juice may be obtained. Operation of the apparatus is as follows : The juice is normally kept in large tanks (not shown) located at a level above that of the carbonating apparatus and is mixed with the proper amount of lime before entering the apparatus. On opening the valve 7 the limed juice passes into the first tube at an approximate pressure of to 3½ lbs. and the pressure of the gas is at all times maintained constant and equal to the juice pressure, both pressures being regulated exteriorly of the apparatus. Juice valve 7 is first opened about half and the alkalinity is fixed to the desired amount, after which the main gas valve 11 is opened and the alkalinity regulated by the valve 15. This valve 15 is never touched after the apparatus is set in operation, but the waste gas valve 16 connected with the vessel is now partially closed and a pressure created in this vessel, which pressure acts on the diaphragm 19 to force the disc 24 to take the position at the large end of the conical opening 25, when the commercial gas employed runs 10 per cent. in carbonic acid content, and into the centre of the opening if the gas contains 30 per cent. carbonic acid gas. It is obvious that the pressure of the waste gas will be greater with the same opening of the valve 16 as the carbonic acid content of the gas used decreases. Next, to correct the change in alkalinity caused by more gas going into the second tube, due to the increase in area around the disc 24, the juice valve 7 which was partly open is further opened to bring the alkalinity of the juice back to the original state. The valve 15 permits the same quantity of gas to enter regardless of the percentage of carbonic acid in the gas. As the commercial gas increases in content of carbonic acid the waste gas coming from it decreases and hence the volume leaving the waste valve will be less, causing the pressure of the waste gas to decrease, thus reducing the pressure on the diaphragm 19. Thus disc 24 due to this decrease in pressure rises cutting down the amount of gas going into the second tube, and thereby restores the original alkalinity. The valve disc 24 and the opening 25 are designed for gas ranging from 20 per cent. to 40 per cent. in carbonic acid content which is the usual range of the the gas delivered by the kilns now is use.

PRODUCTION, APPLICATION AND REVIVIFICATION OF ACTIVATED (DECOLORIZING CARBON. (*A*) **Paul Mahler** (assignor to the **Darco Sales Corporation**). 1,617,533. February 15th, 1927. (*B*) **Georg Müller**, of Frankfort-on-the Main, Germany. 1,617,960. February 15th, 1927. (*C*) **Charles B. Davis**, of New York. 1,618,148. February 15th, 1927. (*D*) **Otto Ernst and Otto Nicodemus**, of Hochst-on-the-Main, Germany (assignors to the **I. G. Farbenindustrie A.-G.**, of Frankfort-on-the-Main). 1,621,195. March 15th, 1927. (*E*, *F*) **Robert N. Riddle** (assignor to the **Riddle Process Co., Inc.**, of New York, U.S.A.). 1,643,031. September 20th, 1927.

(*A*) Claim is here made for the process of revivifying an absorbent which has been used on aqueous solutions, which consists in subjecting the same to chlorine gas at a temperature below 100°C. (*B*) A process of recovering adsorbed material from adsorptive material comprises circulating heating gases in a path including a zone of heat transfer relationship with the adsorptive material, introducing fresh heating gases into the circulating gases at a point in said path in front of said zone and withdrawing a portion of said circulating gases from said path at a point behind said zone. (*C*) A step in the process of producing an absorbent decolorizing medium consists in "cracking" a heavy distillate to attain a gas of lighter density, mixing the same with a limited amount of air, and absorbing the mixture in a porous carbon base. (*D*) In processes for the production of highly active charcoal involving the carbonization of carbonaceous material in the presence of an acid of phosphorus claim is made for the step which consists in carbonizing the impregnated carbonaceous material in the presence of a gas containing free oxygen in quantity sufficient to

substantially prevent reduction of the acid of phosphorus. (*E*) Claim is made for the process of forming a filtering body which comprises the following steps : First saturating a mass of finely divided soft coal with a solution of an alkali-metal carbonate and allowing the said solution to crystallize ; second, air drying said mass at a temperature below the point of fusion of said carbonate ; third, heating the dried mass in a reducing atmosphere at and below the temperature of red heat ; fourth, further heating the mass to a cooling temperature in the presence of a material which will combine with the volatile constituents of the coal ; fifth, treating the mass so produced with a material which will remove the compounds formed in the coking steps, leaving as a residue a mixture of pure carbon with the alkali-metal carbonate, and sixth, separating out the carbonate, leaving the body of finely divided, porous carbon. (*F*) Further for the process of forming a filtering body which comprises the following steps : forming a dry crystalline mass of an alkali-metal carbonate combined with a uniformly disseminated finely divided body of soft coal, subjecting said mass to the action of a reducing gas at temperatures below 290°C. until the gases evolved burn with a blue flame, and then subjecting the residue to temperature progressively increasing from 650 to 1050°C. in presence of nitrogen gas, and passing dry steam over the coked mass, and washing the said residue subsequently remaining to remove the alkalis therefrom.

Beet Topping Machine. **Gensuke Isago,** of Ely, Nev., U.S.A. 1,637,644. August 2nd, 1927. A machine of the class described comprising a vehicle, a pivoted hanger supported by said vehicle, knife means mounted upon said hanger, and means for counter-balancing said hanger comprising a weight having its effective leverage normally fixed, and another weight having its effective leverage automatically varied in accordance with the height of vegetation being cut by the machine.—Sugar Beet Seed Dropper. **Andrew A. Matheson,** of Denver, Colo., U.S.A. 1,638,048. August 9th, 1927. A beet seed dropping device comprising, in combination, a hopper provided with an inclined bottom and a vertical wall extending upwardly from the lowest part of the hopper, a shaft mounted for rotation in the hopper, a perforated disc secured to the shaft so as to have one side in contact with one surface of said vertical end wall, a plate secured to the end wall and lying against the other side of the disc, said disc being in communication with the interior of said hopper through an opening which is intersected by the locus of travel of the perforation in said disc, the wall that separates the disc from the interior of the hopper having also a small opening which is intersected by the locus of travel of the perforations in the disc, a source of compressed air connected with said last named opening, a valve mechanism in said air connexion, means for rotating the disc and means for opening the valve and permitting a flow of air whenever an opening in the disc comes into alignment with the opening in the wall whereby a blast of air will pass through the perforation and tend to clear the same.—Fermentation of Cellulose. **Herbert Langwell,** of Epsom, England. 1,639,571. August 26th, 1927. A process of obtaining alcohol comprises preparing a mash of cellulose-containing material, inoculating said mash with an organism which is adapted to attack cellulose and thereby to produce ethyl alcohol and aliphatic acids, allowing said mash to ferment with aeration and increasing the degree of aeration above that at which mainly aliphatic acids are formed, until mainly ethyl alcohol is produced.—Rectifying Columns. **James F. Cyphers,** of Baltimore, Md., U.S.A. (*A*) 1,640,068. August 23rd, 1927. (*B*) 1,640,069. August 23rd, 1927. (*A*) In a rectifying column, having a substantially horizontal and unobstructed rectifying plate, means are provided to cause liquid to be rectified to flow in one direction over said plate, said plate having therein spaced rows of spaced vapour nozzles, the upper portions of said vapour nozzles having one dimension greater than the other, the greater of said dimensions extending transverse to the direction of liquid flow. (*B*) In self-cleaning beer-plates adapted to hold material to be rectified, projecting covered members in said plate having two vapour outlet orifices between and adjoining said plate and the walls and tops of each of said members, said projecting members being adapted to cause the vapours coming through said orifices to agitate the material on said plate.

Sugar Crops of the World.

(Willett & Gray's Estimates to October 20th, 1927.)

	Harvesting Period.	1926-27. Tons.	1925-26. Tons.	1924-25. Tons.
United States—Louisiana	Oct.-Jan.	42,112	124,447	79,002
Texas	" "	—	—	—
Porto Rico	Jan.-June	558,800	541,485	589,760
Hawaiian Islands	Nov.-June	714,285	705,350	692,804
West Indies—Virgin Islands	Jan.-June	7,077	5,664	7,200
Cuba	Dec.-June	4,508,521	4,884,658	5,125,970
British West Indies—Trinidad	Jan.-June	52,204	73,561	69,628
Barbados	" "	56,183	47,535	49,315
Jamaica	" "	65,280	57,675	42,843
Antigua	Feb.-July	23,501	12,800	17,300
St. Kitts	Feb.-Aug.	14,108	16,380	15,563
Other British West Indies	Jan.-June	4,969	7,550	6,253
French West Indies—Martinique	Jan.-July	45,039	48,121	47,995
Guadeloupe (1927-28 31,000)	" "	35,673	32,998	39,990
San Domingo	Jan.-June	303,524	354,720	311,270
Haiti	Dec.-June	12,563	10,044	8,280
Mexico	" "	181,858	190,282	165,223
Central America—Guatemala	Jan.-June	33,000	25,151	25,562
Other Central America	" "	70,000	62,500	73,240
South America—				
Demerara	Oct.-Dec. and May-June	95,000	107,580	90,874
Surinam	Oct. Jan.	13,000	10,000	10,200
Venezuela	Oct.-June	19,000	21,321	20,625
Ecuador (1927-28 16,000)	Oct.-Feb.	18,000	16,976	18,700
Peru	Jan.-Dec.	275,000	265,000	310,522
Argentina (1927-28 350,000)	May-Nov.	475,695	395,733	246,717
Brazil (1927-28 650,000)	Oct.-Feb.	850,565	676,524	812,493
Total in America		8,474,957	8,694,055	8,877,329
Asia—British India	Dec.-May	3,208,000	2,977,000	2,548,000
Java (1927-28 2,350,000)	May-Nov.	1,959,948	2,278,900	1,977,490
Formosa and Japan	Nov.-June	499,425	616,584	554,473
Philippine Islands	" "	584,238	436,705	581,064
Total in Asia		6,251,611	6,309,189	5,661,027
Australia (1927-28 467,000)	June-Nov.	415,611	522,344	435,680
Fiji Islands	" "	85,000	70,567	100,810
Total in Australia and Polynesia		500,611	592,911	536,490
Africa—Egypt	Jan.-June	90,000	94,286	79,918
Mauritius (1927-28 215,000)	Aug.-Jan.	192,590	241,220	224,710
Réunion	" "	56,579	59,015	52,380
Natal (1927-28 245,000)	May-Oct.	216,305	214,152	143,974
Mozambique	" "	80,000	59,841	44,278
Total in Africa		635,474	668,514	545,260
Europe—Spain	Dec.-June	7,500	8,704	7,661
Total cane sugar crops		15,870,153	16,273,373	15,627,767
Europe—Beet sugar crops		6,839,594	7,441,320	7,083,068
United States—Beet sugar crop	July-Jan.	801,246	804,439	974,185
Canada—Beet sugar crop	Oct.-Dec.	28,250	32,475	36,200
Total beet sugar crops		7,669,090	8,278,234	8,093,453
Grand total Cane and Beet Sugar	Tons	23,359,243	24,551,607	23,721,220
Estimated decrease in the world's production	"	1,012,354	*830,387	*3,605,111

* Increase.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1927 Tons.	1926 Tons.
Total Receipts, January 1st to Oct. 26th	2,635,590	2,912,429
Deliveries „ „	2,617,144	2,759,700
Melting by Refiners „ „	2,586,598	2,755,000
Exports of Refined „ „	100,000	76,500
Importers' Stocks, October 26th	133.309	161,385
Total Stocks, October 26th	202,571	210,363
	1926.	1925.
Total Consumption for twelve months	5,671,335 ..	5,510,060

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR,
1925, 1926, AND 1927.

(Tons of 2,240 lbs.)	1925 Tons		1926 Tons		1927 Tons
Exports	4,082,059	..	3,715,725	..	3,299,983
Stocks	639,439	..	603,469	..	671,953
	4,721,498	..	4,319,194	..	3,971,936
Local Consumption	107,000	..	110,000	..	111,000
Receipts at Ports to September 30th..	4,828,498	..	4,429,194	..	4,082,936

Havana, September 30th, 1927. J. GUMA.—L. MEJER

Beet Crops of Europe.

(Willett & Gray's Estimates at October 27th, 1927.)

	Harvesting Period	1926-27. Tons.	1925-26. Tons.	1924-25. Tons.
Germany	Sept.-Jan.	1,657,088	1,595,545	1,575,684
Czecho-Slovakia	Sept.-Jan.	1,032,264	1,485,031	1,411,101
Austria	Sept.-Jan.	79,498	78,145	75,443
Hungary	Sept.-Jan.	173,470	172,560	202,354
France	Sept.-Jan.	720,883	757,987	834,138
Belgium	Sept -Jan.	233,421	332,170	400,105
Holland	Sept.-Jan.	287,427	306,083	332,723
Russia (Ukraine, etc.)	Sept.-Jan.	859,380	1,041,903	458,375
Poland	Sept.-Jan.	552,553	575,673	494,854
Sweden	Sept.-Dec.	20,871	204,500	135,270
Denmark	Sept.-Jan.	151,119	179,998	149,995
Italy	Aug.-Oct	313,738	160,926	422,429
Spain	Sept.-Jan.	290,000	243,939	252,040
Switzerland	Sept.-Jan.	7,950	6,395	5,906
Bulgaria	Sept.-Jan.	31,485	38,309	39,758
Roumania	Sept.-Jan.	162,821	115,907	86,256
Gt. Britain and Ireland	Sept.-Jan.	165,465	51,784	23,730
Other Countries	Sept.-Jan.	104,000	94,465	191,907
Total in Europe		6,843,433	7,441,320	7,083,068

United Kingdom Monthly Sugar Report.

Our last report was dated 10th October, 1927.

Business on the London Market has been slow during the period under review, and prices have been on the easy side, until the last few days, when firmer markets have prevailed.

The Terminal Market has been chiefly concerned with the liquidation of accounts and large quantities of December have been transferred to March, May and August. No fresh speculative movement has been started owing to the pessimistic views held by the majority of operators. October at the end of the month was sold at 3d. premium over November, as a few "bears" had left it rather late to cover. About 10,000 tons of sugar were tendered at the end of October and this month finally finished at 14s. 1½d.

November sold from 14s. to 13s. 9d., December from 14s. to 13s. 8½d., March from 16s. to 15s. 8¼d., May from 16s. 3d. to 15s. 11¼d., and August from 16s. 6d. to 16s. 3d. From the lowest point there has been a recovery during the last few days, and December sold up to 14s. 4½d., March to 16s. 3d., May 16s. 6¾d to 16s. 6d. and August to 16s. 9d. There was a poor demand for actual sugar, until recently when the trade, who owing to their hand-to-mouth policy were very short of stock, came in and bought considerable quantities. So far there has been no real pressure of Continental Sugars, but ready granulated has been sold down to 14s. 7½d. The latest price, however, is 15s. November/December sold 14s. 6d., January/March 14s. 9d., whilst April/June sold 15s., and March/August 15s. 1½d. Spot Sugar also suffered in the general depression and fell from 28s. to 27s. 3d., but is held to-day for 27s. 10½d., whilst old landed can be bought at 27s. 6d. German Granulated is offering on the spot, but is not selling very readily. White Javas were sold 14s. 9d. c.i.f. for May/June shipment, but not much business is passing.

Home Grown Factories have continued to press their sugars, and the price declined from 29s. to 27s. 7½d., but during the last few days it is estimated that at least 20,000 tons have been taken by the trade, and the price is now up again to 28s. 3d.

Refiners have not received a large share of the business, and on October 17th, they reduced their price by 6d. per cwt., again on November 1st, they were reduced a further 3d. per cwt., but on November 9th, they were raised by 3d. per cwt., the latest price being No. 1 Cubes 32s., London Granulated 29s. 1½d.

Raws have been quiet and very little business passing. Small quantities of Brazils, Perus and Argentines have been sold from 11s. 10½d. to 12s. c.i.f. A feature during the month has been the sale of 150,000 tons of Cuban 96 per cent. to the British Refiners at 11s. 7½d. c.i.f. This sugar was sold by the newly formed Sugar Export Commission, operating in Havana, under the Tarafa Bill. This is the first evidence of the Cuban policy of exporting a definite surplus to countries other than America at the world's parity, and keeping the price high in the United States. Whether such a state of affairs can exist for a long time is problematical.

In America conditions have been very quiet, and the excitement caused by the Tarafa Bill appears to have died down. No announcement has yet been made as to the size of the next Cuban crop, but Colonel TARAFA is now on a visit to Europe and on November 10th he will meet in Paris representatives from most of the producing countries in Europe, to ascertain if some plan can be formed to link up Europe and Java with Cuba in one general restriction scheme. So far the prospects look anything but favourable for such a scheme to succeed. Raws in America sold down to $2\frac{1}{16}$ and a fair business was done at this price. The Future's Market has remained practically level the whole time.

With regard to Europe, F.O. LICHT made slight alterations in his second estimate of the crop, but finally increased the total from 8,101,000 to 8,206,000 tons.

21, Mincing Lane,
London, E.C.3.
10th November, 1927.

ARTHUR B. HODGE,
Sugar Merchants and Brokers.

THE

INTERNATIONAL SUGAR JOURNAL.

☞ All communications to be addressed to "The International Sugar Journal," 2, St. Dunstan's Hill, London, E.C. 3.

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The Editors will be glad to consider any MSS. sent to them for insertion in this Journal, and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

No. 348. DECEMBER, 1927. VOL. XXIX.

Notes and Comments.

The Cuban Sugar Mission to Europe.

The centre of interest in world sugar circles during the past month has of course been the mission of Colonel TARAFA, the delegate of the Cuban President, to Europe in the hope of obtaining some agreement with European and Javan sugar producers to regulate production of sugar, so as to bring it into more economic relation with world consumption.

Colonel TARAFA first went to Paris where he met in conference representatives of the sugar-exporting countries of Germany, Czecho-Slovakia and Poland. An agreement was afterwards stated to have been come to, but as it could at that stage only be a preliminary one, the delegates were reticent as to the precise details. An official communique was issued which stated that the parties in question has agreed " to normalize and stabilize relations between production and consumption of sugar throughout the world. Fundamental arrangements have already been made as regards the 1927-28 season and preparation for the 1928-29 season, by common accord of all the delegates. An International sugar committee will be formed . . . . . whose principal function will be the regulation of the production and consumption of sugar throughout the world."

The Cuban representative then went on to Amsterdam to confer with the Dutch-Java interests in the hope of getting like agreement. In the end he is stated to have got further towards reaching an understanding than at first seemed likely; but after what are officially described as " four friendly conferences " the only conclusion arrived at was seemingly that the two parties will " maintain contact with each other and will continue their co-operation so far as this will be to their mutual interest."

The Pros and Cons of Agreement.

Both at Paris and at Amsterdam the official reports of the conferences have been vaguely worded, and speculation is rife and somewhat sceptical as to the actual achievement. It is variously asserted that the European representatives are not really willing to reduce production but at most have agreed merely not to increase production further; that they haveonly agreed to effect some limitation of exports and devise better means of marketing

the sugar; that all they can consent to do is to take concerted steps to increase the consumption of sugar. In the end we may hear before long precisely what the outcome of their negotiations amounts to; but it is obvious that while all parties to the discussions would welcome any steps that would tend to raise sugar prices to a more economic level and then stabilize them, individual parties are not prepared hastily to abandon the advantages their country is thought to have gained as an exporting unit in the world sugar market. Cuba undoubtedly views with apprehension the extent to which European beet is gradually attaining once more its pre-war percentage of the world's sugar supply; Europe takes the view that Cuba having doubled her pre-war supply of sugar is the main cause of over-production, but she cannot altogether overlook the fact that during the war Cuba was certainly encouraged to increase her supply and provide the then deficiency in world sugar. European producers are doubtless aware too that if the rejection of Cuba's overtures resulted in the latter abandoning all attempts at restriction her potential output of six million tons or more of sugar per annum would tend to glut the world's markets and reduce sugar again to entirely uneconomic prices. But Cuba obviously desires to avoid any such desperate expedient, which would probably result in throwing her back under the domination of the American sugar market—a domination in the past that has probably had a good deal to do with her present attempt to come to terms with other world producers. So the parties to the negotiations in Paris have undoubtedly each some cause to try and come to an agreement if it can be drawn up on a basis that will penalize nobody unduly.

As regards the attempt of Colonel TARAFA to draw into the agreement the Java sugar producers, it may be assumed that the latter will be willing to co-operate if they can see anything to their ultimate advantage; but they are chary of compromising their present strong position as cheap producers. Although factors are not quite so favourable for Java as they used to be, she still leads in the matter of cheapness of sugar production and can easily beat Cuba at that game; her latest asset, on which a good deal of faith is being pinned, is her new POJ 2878 cane variety which is being planted this year for the first time on a large scale, and since Java has under her land laws about reached the limits of acreage she can put under cane, it follows that an era heralding a cane that promises to give much larger yields per area planted is not one for any hasty consent to restrict production. So it seems unlikely that Java's co-operation with Cuba will be of more tangible a nature than was her attitude, in the matter of rubber production, to the British proposals under the Stevenson scheme of restricting output. But even Java will lose nothing by helping to stabilize prices at a somewhat higher level, so it is just possible that the Amsterdam negotiations will not be altogether fruitless.

Production during 1927-28.

At this stage one naturally turns to the forecasts of the sugar statistical experts in respect to the sugar season just begun. WILLETT & GRAY have just published their rough estimate of the world crops for 1927-28, and its contrast with 1926-27 is rather striking, for whereas the latter year showed a decrease over 1925-26 of nearly a million tons, the coming season promises to more than wipe this out, the estimated increase over 1926-27 being put at 1,245,133 tons. This is a quarter of a million tons more than in 1925-26, in spite of Cuba's share being less by 884,658 tons than it was two years ago. The world totals are: 1925-26, 24,583,909 tons; 1926-27,

23,590,867 tons; 1927-28 (estimated), 24,836,000 tons. But when we analyse the figures (which will be found on page 678) we find that the increase is entirely due to the expansion of beet sugar in Europe (and to a slight extent also in America); cane sugar in America, thanks mainly to Cuba, is down (as compared with last year) by some 800,000 tons, and the total cane sugar crops of the world promise 200,000 tons less than last season. But European beet reveals an estimated expansion over 1926-27 of no less than 1,345,000 tons, and the total world's beet crop is put at a possible 9,135,000 tons, as compared with 7,689,748 tons. It should be observed, however, that since these estimates were published by the New York house, LIGHT has reduced his European estimate by 112,000 tons. Still the net expansion remains very considerable, and may well give the Cuban producers cause for uneasiness.

While the present estimated figure of 24,836,000 tons is a new record in production, the position of consumption is rather more problematical. But Mr. GOLODETZ, of London, points out in a recent circular that visible consumption in the principal countries of Europe and America during 1926-27 proved deficient as compared with the previous year by about 7 per cent. Hence if the forthcoming consumption data during the current season show on the average an excess on the figures of a year previously of 7 per cent., such a result would merely signify a return of the pace of consumption to the state of 1925-26. There would be nothing surprising if the jump amounted to 10 per cent.; but if it amounts to no more than 7 per cent., it would show a total of increased needs of the world of 1¾ million tons, which is more than the increase shown for the world crops in the preliminary estimates. So there is fair ground for assuming that consumption will not lag behind production during 1927-28.

Beet Sugar Experiments in Louisiana.

It has been reported lately that proposals were on foot to produce beet as well as cane sugar in Louisiana factories, and so utilize the factories over a longer period of the year. But the opinion of those who are best fitted to judge of the practicability of the proposal does not appear to be favourable to the experiment. Doubtless the latter had its genesis in the desperate condition to which the Louisiana cane sugar industry was brought a short while ago; but the more or less complete replacement of the existing degenerate cane varieties in that State by well known and proved Java POJ canes has altered the situation.

Even were the results from beet sugar experiments, so far carried out, an unmitigated success, it is doubtful whether the necessary capital would be forthcoming to equip the factories with the requisite diffusion plant. As an article on another page from the pen of Mr. A. H. ROSENFELD points out, the Louisiana planters will have difficulty enough to find the capital to tide them over the effects of the recent flood and the transit period of changing cane varieties; to find also capital for establishing a new and untried addition to their factory routine would hence probably prove an impossibility. But the sugar beet results seem to us to have been anything but encouraging, the field yields having been in most cases disastrously low, and even in a favourable season have not averaged over 9 tons per acre. In fact, the Louisiana Experiment Station has been decidedly quiet regarding the results. It has found that unless the beets are sown in the fall or winter and harvested in the warm weather, say from April to June, there is a strong tendency for the roots to rot. But harvesting at such a time means in-

creased danger of rotting while the roots are in transit, while it is obvious that the roots cannot store up the sugar during the warm weather to the degree they do everywhere else where they are harvested in the autumn or winter.

But if the new Java canes fulfil their earlier promises, as seems now very probable, they will go a long way towards rehabilitating the Louisiana cane sugar industry, and there will then be no particular inducement to experiment in a dual production of dubious promise. Attention will more properly be concentrated on making the most of the new field achievements in respect to sugar cane.

Argentina producing to Excess.

On another page we give a long paper from the pen of Mr. Arthur H. Rosenfeld, detailing the advantages expected for Louisiana from the introduction of Java canes and drawing a lengthy parallel between this and some very similar history is respect to Argentine canes. The story of the latter is well known by now, and it is to be hoped in the interests of Louisiana that a like measure of success will accrue to her own attempt to substitute more virile cane varieties for the degenerated types that have so long done duty in America's mainland cane sugar tract.

But there appears to be, if we do not misread the facts, an aftermath to the Argentine success which will not be altogether agreeable to the cane planters there. The Department of Overseas Trade learns from Buenos Ayres that Argentina will, with this season's output and including the already existing surplus stocks, have available some 650,000 tons of sugar to supply a domestic consumption demand until next season of some 330,000 tons. It will be necessary therefore to export about 320,000 tons, of which, so far, only 50,000 have been shipped. Argentina has never loomed large as an exporter of sugar and can only dispose of this surplus, if at all, by dumping it at an uneconomic price which means in practice that the loss occasioned by the exportation is borne by the planters pro rata to their output. Retrenchment in the acreage planted with cane seems then the most natural sequel since there can be no real incentive to continue producing more sugar than can be profitably disposed of, and it is not surprising to learn that the 1927-28 crop is forecasted as some 135,000 tons less.

The Italian Beet Sugar Campaign.

According to a report received from a correspondent in Italy, the beet sugar industry in that country was not able to work this campaign at full capacity, owing to an irregular supply and scarcity of the roots, occasioned chiefly by an abnormal dryness in the weather which impeded the normal development of the beets. But the sugar content is stated never to have been so high as this season, and this had alleviated the situation, if not wholly compensating for the damage caused by the dry weather. The production of sugar has attained to about 260,000 tons, or some 24,000 tons less than last year. The price of sugar has been reduced to 220-225 lire per 100 kilos for refined, which, together with the 400 lire of manufacturing tax, makes the wholesale price 620-625 lire. This price has to compete with foreign quotations in spite of 85 lire per 100 kilos Customs duty. The lower earnings made under the new beet contracts are equally distributed between the factories and the growers. These latter will receive 14 lire per 100 kilos of roots as compared with 16 lire last year (about 33s. per ton at present rates of exchange). Next campaign the number of hectares sown is expected to be larger, and it is hoped to bring the Italian sugar production up to a

level that will cover the entire internal consumption. Although the tax on imported second-class sugar has been reduced, the Customs have found some compensation in the larger quantities that have entered. The consumption itself has shown no reduction, and during the summer imports had to be increased to make up for the insufficient stocks of the home grown sugar available for the consumer.

Company Results in India.

Three of the sugar concerns managed by Messrs. Begg Sutherland & Co., of Cawnpore, India, have recently issued their accounts for the year ended last June and all three show profits, as compared with debit balances last year. The CHAMPARA SUGAR COMPANY's profits amount to just over three lakhs of rupees (say £20,000) on an ordinary share capital of £80,000, after paying interest on £40,000 worth of debentures, commissions, bonus to cane growers, and taxes. After applying large sums to various reserves, a dividend of 8 annas per R.10 share has been paid, absorbing 60,000 rupees (£4000) and 17,225 rupees are carried forward. Since, last year, there was a deficit of over £4500, the latest results may be considered satisfactory. Of the sums placed to reserve, the largest—£12,000—is devoted to the debenture sinking fund. The RYAM SUGAR COMPANY made a profit after the same allowances of 150,891 rupees (say £10,059) but as there was a debit at profit and loss from the previous year of almost £5900, it has been necessary to transfer £3425 from the general reserve in order to make up the necessary depreciation account, and about £1500 has been carried forward, no dividend being possible. Finally, the SAMASTIPUR CENTRAL SUGAR COMPANY shows a net profit of 300,592 rupees (say £20,040); but as there was the previous year a deficit of £5045, and £8000 is now placed to the debenture sinking fund and £5000 to depreciation reserve, there remains only the sum of £1993, which is carried forward, no dividend being paid.

These improved results, which it is to be hoped will be maintained if not enhanced in succeeding years, undoubtedly reflect the better technical control at these factories as well as the higher returns from the Coimbatore canes which have been introduced of late years. Meantime the financial position of the factories is strong, as the conservative policy of the directors has been to build up good reserves. It may be noted that in future the financial year is to run from November 1st to October 31st, thereby more nearly coinciding with the cane manufacturing season; so the current year will have a term of 16 months.

India's Sugar Imports.

But in spite of the improvements in existing factories India seems little nearer the day when she can dispense with imports of sugar. According to the Calcutta paper, *Commerce*, during the 12 months ended March last, imports expanded by 120,000 tons, no doubt owing to larger arrivals of beet sugar, of which some 87,000 tons reached Bombay, mainly from Germany, Austria, Poland, Czecho-Slovakia and Belgium. In addition to those countries, Russia entered the Bombay market—with a shipment of over 13,000 tons. On the other hand, the preferential treatment accorded to Empire sugar in the United Kingdom has led to the virtual disappearance of Mauritius sugar from the Bombay trade returns. But most of the Indian imported sugar comes from Java; and during the year under review this latter country sent to India as much as 807,674 tons, compared with 771,029 tons in 1925-26, and 563,053 tons in 1924-25.

Fulton Iron Works Company.

The Fulton Iron Works Company has taken an important step in securing as the Manager of its Sugar Factory Division Mr. E. W. KOPKE, the well-known sugar technologist and engineer, who has for many years past been associated with numerous improvements in the design and arrangement of sugar factories in the Philippines, aiming at lower production costs and higher recoveries. His association now with the Fulton Iron Works Company will doubtless consolidate that firm in its position as one of the biggest producers of sugar machinery in the United States.

Mr. KOPKE has had a long career in the cane sugar industry. He was born in Hawaii, where his father was a pioneer in the cane sugar world there. His education included a post graduate course at Audubon Sugar School, Louisiana, and his first sugar engineering post was at a factory in that State. From 1912 to 1918 he was factory Superintendent for the Makee Sugar Co. in Hawaii, thereafter going to the Philippines where in 1920 he assumed operative control of all the Government centrals and has since been associated with these centrals in one capacity or another. Under his skilled supervision their output has considerably increased and the cost of production been reduced.

Home Beet Sugar Notes.

The present home beet crop, in spite of the weather, is reported to be a fair average one. The earlier consignments were somewhat deficient in sugar but improvement has been shown in subsequent lots; the roots generally are healthy though rather small. The Ministry of Agriculture is well satisfied with the reports reaching it regarding the quality of the harvest. Unfortunately the weather of November has made the lifting of the roots rather difficult, and the tare for dirt registered by the factories has risen appreciably for the time being.

Widespread interest is being shown in mechanical means of harvesting. Beet lifting demonstrations are being given all over the country and some very good lifting ploughs are already on the market. There is also a dual machine, recently imported from Belgium, which tops and lifts the beets in two operations. It is realized that if the cost of harvesting is to be reduced, mechanical aids will have to be adopted as, with a sodden soil, the pace of lifting by hand slackens and the cost goes up. Close attention is therefore being given to any promising contrivance put on trial by the implement makers.

Progress is being made with the project to erect a beet factory at Brigg, Lincolnshire, and providing the necessary number of contracts with farmers can be secured, Sugar Industries Auxiliaries Ltd. of London propose to erect a factory on a site already purchased. The same promoters are planning a factory in the Staffordshire area (between Lichfield and Tamworth) in a rich agricultural district, where it will serve a radius including Derbyshire, Warwickshire and Leicestershire,

Berkshire may also have a factory before long, as another promoting company, The Sugar Beet Products Ltd., of London, are prepared to erect one near Radley if sufficient promises of beet are obtainable from the farmers of the district. In this case it is intended to have the factory constructed to the designs of the Dyer Co., and Sir Robert McAlpine & Co. are to be the constructors.

Home Beet Sugar Notes.

The Ministry of Agriculture has recently issued under the provisions of the "British Sugar (Subsidy) Act, 1925," an annual statement in the form of balance sheets, showing the financial results of all the beet sugar factories in this country for the last season. All but two showed more or less large profits.

The profit balances shown for the several concerns were as follows :—

	£	s.	d.
English Beet Sugar Corporation Ltd. (Cantley) ..	90,101	8	0
Home Grown Sugar Ltd. (Kelham)	3,125	0	0
Ely Beet Sugar Factory Ltd...	56,250	0	0
Ipswich Beet Sugar Factory Ltd.	50,000	0	0
Anglo-Scottish Beet Sugar Corporation Ltd. (Colwick and Spalding)	63,119	8	1
West Midland Sugar Company Ltd. (Kidderminster)	46,358	14	9
Second Anglo-Scottish (Poppleton, Felstead and Cupar)	17,524	5	11
United Sugar Company Ltd. (Bury St. Edmunds)	45,197	18	10
Central Sugar Company Ltd. (Peterborough) ..	45,419	9	6

The two concerns that showed continued losses were the Wissington factory of British Sugar Manufacturers Ltd. whose adverse balance was increased from £39,040, as shown in the previous balance sheet, to £83,871 17s. 8d.; and the Greenock sugar factory of the Orchard Sugar Co. Ltd., whose debit balance of £42,214 from last year has been increased by £46,932, and now stands at £89,960 14s. 4d. Of the successful factories the most prominent case is perhaps that of Bury St. Edmunds, which made a gross profit of £198,980 and out of this has written off the preliminary expenses and wiped out a debit balance of the previous year amounting to £63,246, besides putting £44,300 to depreciation and £20,000 to income tax reserve.

Full particulars can be gleaned from the official Statement which is published by H. M. Stationery Office at the price of 3d. net.

A. Bonazzi[1] has made a study of the correlation between the composition of the cane and the soil on which it has been grown, and from topographic and geologic maps of Cuba he has been able to draw certain conclusions : He finds that the potash in the bagasse increases with the calcium in the soil, as does also the phosphoric acid in the press-cake (*cachaza*). The K_2O (potash) in the ash and P_2O_5 (phosphoric acid) in the press-cake can be taken as indicators of the salt content of the cane juice, these two constituents affecting the crystallizing capacity of the massecuites derived from the juices of those regions. Cane grown in soil of a silicious nature is shown to yield highly melassigenic juices.

The late Sir Arthur Shipley had stated at a luncheon given by the Imperial College of Tropical Agriculture to the Dominion Premiers in November last that graduates from the Mauritius Agricultural College are placed in a disadvantageous position in the British Empire, through their lack of knowledge of the English language. The Société des Chimistes of Mauritius now point out that this statement is inaccurate and is one likely to have a harmful effect towards Mauritians in British sugar-producing countries. Students joining the Mauritius Agricultural College pass from the Royal College of Mauritius, where English is the medium of instruction. Further, on the statement of Dr. H. A. Tempany, the Principal of the Mauritius Agricultural College, most of the courses are given in English at this College, and its graduates are as fit to take up work in English speaking countries as any other Britisher. To this we add that Mauritians have already a very high reputation as practical agriculturists and sugar makers that carries them far in all British sugar-producing countries in which they may be engaged.

[1] *Tropical Agriculture*, 1927, 4, 196.

Defects of the Circular Saw for the Preparation of Beet Pulp for Analysis.

By ARM. LE DOCTE.

It has come to my attention that circular saws are still being used for the preparation of pulp for the determination of sugar in the beet by the cold water digestion process, in spite of the fact that this apparatus, and likewise the Kiehle and similar rasps, have long been recognized to be quite defective. They produce pulp which certainly does not represent the average composition of the whole of the root, the portion removed being almost always considerably richer in sugar than the average.

An examination of the sketches herewith demonstrates clearly the reason of this, the first (Fig. 1) showing the section made by means of a circular saw, and the second (Fig. 2) that made by the Pellet conical rasp (Fig. 3), the apparatus which is recommended by me for the preparation of fine pulp for use with

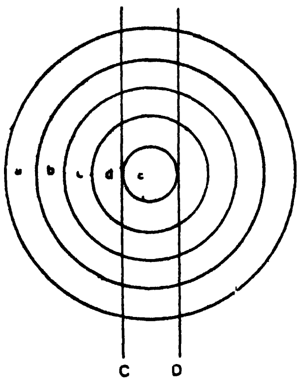


FIG. 1.

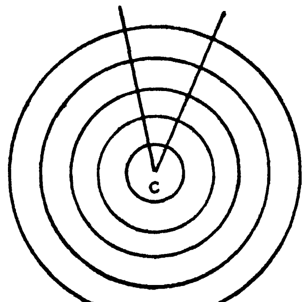


FIG. 2.

the Sachs-Le Docte method. It is seen that the circular saw removes the same quantity of pulp from all the zones, a principle that is quite wrong. These five zones have not only different sugar contents, but their respective weights vary proportionally from 1 to 9, as may be seen from the following statement of weights and sugar contents, which are here given by way of example :—

Zone	Proportional Weight.	Sugar Content per cent.
a	9	16·0
b	7	16·5
c	5	17·2
d	3	17·0
e	1	16·5

It results, therefore, that the sugar content of the pulp thus removed may be from 0·8 to 1·0 per cent. higher than the actual content of the whole of the root. On the other hand, the Pellet conical rasp removes from each of the five zones a proportional section which exactly represents the average composition of the whole of the root, whatever may be the sugar content of each of the zones. It should also be pointed out that the circular saw cuts the root into two parts, which operation does not enable one to rasp once in the small diameter and a second time in the large diameter, as is often prescribed in order to obtain a more exact average. This, however, can be done very easily by means of the Pellet conical rasp.

Defects of Circular Saw for the Preparation of Beet Pulp for Analysis.

The value of the circular saw, and of the Kiehle rasp, was investigated in Belgium in 1913. When in the following year the Belgian Government by a ministerial decree prescribed the process and apparatus which must be employed in the commercial determination of sugar in the beet, the Pellet conical rasp was recommended. But the circular saw and the Kiehle machine were rejected after a very unfavourable report resulting from experiments made by Mr. CRISPO, Director of the State Laboratory at Antwerp.[1]

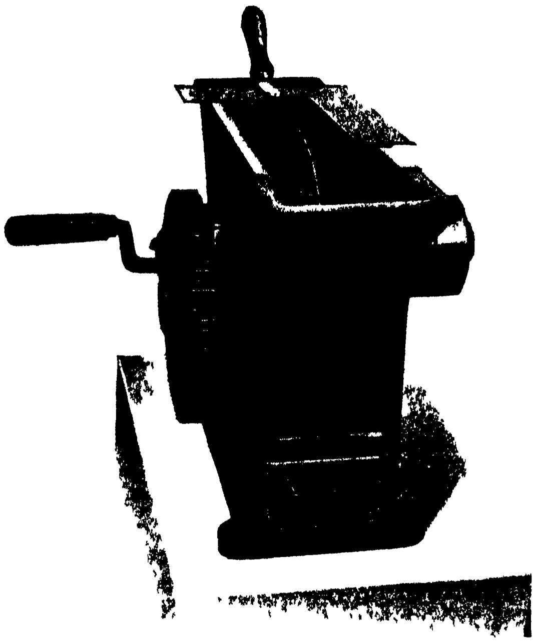


FIG. 3.—THE PELLET CONICAL RASP.

In France the circular saw has long been abandoned. It was 47 years ago when PELLET, on attempting to modify the circular saw, devised his conical rasp, which removes from the root a proportional part from the crown to the tail, and also from the exterior to the centre, thus obtaining an exact sample from the whole of the root with a small quantity of pulp. When this apparatus appeared, the circular saw ceased to be used in France as a means of preparing beet pulp for analysis.

Another defect of the circular saw is that, due to its very rapid rotation, some of the more liquid portion of the pulp is thrown away from the more solid part by centrifugal force. This means that the major portion collected from the tray of the apparatus, which is generally taken for the analysis, contains less sugar than that thrown out against the casing, which latter portion can hardly be collected, and is usually neglected. Hence a further error. Such a condition does not arise with the Pellet conical rasp, provided that it is not rotated faster than the prescribed speed, viz., about 350 revs. per min.

Regarding some of the physical properties of sucrose, different results have been obtained by different observers of repute, as one must have noticed when comparing figures for the specific gravity and the melting point. Prof. Dr. E. O. VON LIPPMANN,[2] now draws attention to some preliminary results published by Dr. W. D. HELDERMAN.[3] Sugar precipitated from aqueous solution by methyl alcohol has a sp. gr. of 1·5713 and a heat of solution of — 813, whereas these two values in the case of sugar precipitated by ethyl alcohol are found to be 1·5860 and — 1095, the first being believed to be an unstable form which gradually passes over to the second. Physical constants hitherto obtained are thought to have been obtained with a mixture of the two modifications, the second probably predominating. They must be established anew, adds Dr. VON LIPPMANN.

[1] *Bull. Soc. Chim. Belge*, January, 1914; *Sucre. Belge*, April, 1914, No. 15.
[2] *Deut. Zuckerind.*, 1927, 52, No. 46, 1283. [3] *Zeitsch. Physik, Chem.*, 1927, 396.

Lessons from the Renaissance of a Sugar Industry.

Parallels between Argentina and Louisiana.

By ARTHUR H. ROSENFELD,
Formerly Director of the Tucuman, Argentina, Sugar Experiment Station,
Consulting Technologist of the American Sugar Cane League.

The sugar-growing country which most closely resembles the State of Louisiana in climatic and soil conditions is that which lies in the little northwestern Argentine Province of Tucuman. While located some four degrees closer to the Equator than the cane area of Louisiana, the average elevation of some 1200 ft. above sea level nullifies the advantage Tucuman would otherwise have over Louisiana in freedom from frost or at least rarer visitations of cold weather. As a result of this elevation and her immediate proximity to the very high and perpetually snow-covered Aconquija chain of the mighty Andes, Tucuman's growing season is just about the length of Louisiana's, and just about the same development of cane and very comparable sugar contents, purities and factory yields can be expected over a series of years in the two countries.

The wide-awake Government of the Province of Tucuman, when in 1907 it decided to establish an experiment station to investigate the constantly decreasing yields of its canefields, recognised the similarity and resolved that it could learn much from Louisiana in regard to facing its problems and conducting a sugar experiment station. Mr. R. E. Blouin, then Director of the Audubon Park Sugar Experiment Station, was immediately engaged by the Commission in charge of the organization of the Tucuman station and, shortly after his arrival in Tucuman in 1908, he secured the services as Sub-Director of the former Research Chemist of the Audubon Park Station, Dr. F. Zerban, now Chief of the New York Sugar Trade Laboratory and at that time Director of the Sugar Experiment Station at Lima, Peru. When the station had been definitely located in 1910 and experimental work actually begun, Mr. Blouin secured the services of the writer, who succeeded Dr. Zerban as Sub-Director when the latter resigned to accept the position of Research Chemist with the Insular Experiment Station of Porto Rico in 1910, and the writer later took Mr. Blouin's place as Director when the latter decided to return to Louisiana in 1914. The new Director was extremely fortunate in securing for the position of sub-Director and Chief Chemist, Dr. W. E. Cross, the Research Chemist of the Audubon Park Station, who in turn succeeded the writer when, in view of the striking success of the Station work, he was induced to accept the management of the large Hileret sugar estates in Tucuman province.

This rather lengthy history of the personnel of the Tucuman Experiment Station is given for the purpose of emphasizing our parallel as showing that, not only are Tucuman conditions very similar to those in Louisiana, but that her problems were tackled by Louisiana-trained scientists, many of them being solved to the great and lasting benefit of that province. And the writer feels sure that he speaks not only for himself but for every other ex-Louisiana member of the old Tucuman staff when he states that each and every one of these men who contributed their bit to the resuscitation of the Tucuman sugar industry, when it was just as gravely menaced as is the Louisiana industry to-day, are more than willing to give any possible assistance or advice in the solving of the very similar problems which have presented themselves in the Louisiana industry some fifteen years after the Tucuman planters began securing Louisiana men to help them.

The P.O.J. Canes save the Tucuman Industry.

It was early seen by the Tucuman Station Staff that the so-called native canes, which were nothing more nor less than our old familiar Louisiana Striped and Purple—another parallel—were indeed decreasing annually in yield and that this decrease was due to a degeneration of the varieties commonly grown. The degeneration was later recognised as being due to mosaic disease—the same dread, insidious scourge which is to-day yellowing the Louisiana fields of Striped, Purple and D 74 canes and reducing her acreage yields to figures which a few short years back would have been thought impossible by even the most pessimistic of her planters—and it was quickly seen that, although investigations along lines of cultivation, systems of planting, fertilization, irrigation, etc., were going to be very necessary and useful, our main line of work must be that of looking toward the finding of some variety or varieties which, either through immunity or tolerance to the scourge, would be capable of replacing the " Creole " canes and once more allow the Tucuman canefields to show profitable yields.

The degenerating effects of the mosaic disease, complicated by the unfavourable climatic conditions of our first years of investigation, manifested themselves more and more clearly in the years 1910, 1911, and 1912. Then came the exceptionally favourable conditions of 1913 and 1914 which dissipated to some extent the fears of the Tucuman planters by once more presenting fair agricultural yields, and, for sub-tropical conditions, splendid industrial recoveries. These yields, however, while relatively good as compared with the immediately preceding years, demonstrated all the more clearly to us at the experiment station that the staple canes of the province were definitely undergoing a process of physiological degeneration, which we now know to be so peculiarly characteristic of the mosaic disease, else the yields under the exceptionally favourable conditions of those years should have easily been doubled in the fields. These opinions and forebodings were more than justified when the unprecedentedly favourable seasons of 1913 and 1914 were succeeded by the no less unprecedentedly *unfavourable* years of 1915, 1916, 1917 and 1918, when Tucuman produced, instead of the 263,000 tons of sugar of 1914, considerably less than half of that amount in 1915 and less than 45,000 tons in 1916 and again in 1917. It would seem that those two years of 1916 and 1917 furnish another parallel with Louisiana conditions of last year (1926), when her fields yielded an average of less than seven tons of cane per acre. In 1918, although conditions were far worse than in any other year in the annals of Argentina's sugar industry, the effects of the new canes which we will now discuss had begun to make themselves notably felt in Tucuman's figures of production, that for 1918 being about as large as the total of the two preceding seasons—despite freezes which for earliness and severity established a glaring new record. Indeed, had it not been for the new canes in the crop of 1917, very little sugar would have been made even then, as the area of the native cane had been cut almost in half by 1916 and not more than ten per cent. of what remained after the disastrous freezes of that year was worth while even cultivating for the 1917 crop. The small amount of the " native " canes which is to-day cultivated in Tucuman is cared for on strictly sentimental and by no means commercial grounds.

Now let us see how this emergency in Tucuman's sugar industry, so remarkably parallel to conditions in Louisiana's industry to-day, was met and if the loss of the staple canes of the province meant the abandonment of the industry, as at one time appeared to be most dangerously probable. As

stated above, while ordinary cultural investigations were by no means neglected, the station concentrated its efforts upon trials of all obtainable varieties, one or more of which might, under the most difficult conditions of the Tucuman climate and of the still more complicated state of affairs brought about by the ravages of disease in her canefields, flourish to a certain extent and at least give superior field and factory yields to the suicidal ones then being obtained from the Purple and Striped.

As soon as the station was established, there were brought from Louisiana some 126 varieties, representing canes from almost all the well-known sugar countries which were being experimented with in Louisiana at that time. In 1910 we secured from the experiment station in Campinas, Brazil, another lot of 76 varieties, some of which represented duplicates of the Louisiana collection, and plantings were also made at the station of six seedling canes from Java, produced by Kobus where the dreaded sereh disease was as seriously menacing the Javanese canefields as mosaic disease was at that time threatening our Tucuman ones—and is to-day holding the sword of Damocles over the heads of the Louisiana planters. These varieties had been imported as a result of the law creating the experiment station by the then Governor and later member of the experiment station board, Hon. LUIS F. NOUGUES. Since that time some fifteen or twenty of the more promising new varieties of different countries have been introduced each year, many of them giving far superior results to those obtained from the native canes even in their halcyon days. Since 1916 Mr. GEORGE L. FAWCETT, the capable botanist of the station, has produced several hundred seedlings in Tucuman, many of them promising mosaic-immune crosses of the tropical canes with the vigorous North Indian type. It was, however, from three of these six seedlings produced at the East Java Experiment Station (Proefstation Oost Java, hence the initials P O J used before the serial numbers of these canes) that we obtained the canes which have since entirely supplanted the native and all other canes in Tucuman and which, if our present parallel works into the future, will very shortly perform similar marvels in Louisiana.

In judging the new canes we had to seek the following points of superiority over the old ones : (1) Greater tonnage of cane with (2) juices containing a higher percentage of crystallizable sugar, (3) greater resistance to the attacks of mosaic and other diseases, as well as to insect ravages, (4) ability to withstand considerably lower temperatures than the "native" canes and (5) the furnishing of more and better fuel in the shape of the bagasse. The latter is of even more importance to Louisiana, where the manufacture of celotex has assumed economic proportions, than to Tucuman.

The discussion would be unduly prolonged were we to enter into details of the various experiments conducted with varieties over the five-year period which were necessary to definitely prove the far superior value, under each of the above points, of the P O J 36, 213 and 234 canes over the "native" and the hundreds of other varieties tried during that period. Suffice it to say that these experiments were carefully conducted under normal field conditions, first at the main station and, after a couple of years' work had indicated the superiority of these three varieties, on large scale substations all over the province, these latter being made not only with the idea of checking up the results at the main station and trying out these canes under the varying conditions of this very diversified little province, but also with that of rapidly multiplying these promising canes to the point that, once any of them had proved to be definitely superior to the varieties generally in use, there would be

material for their rapid extension to meet the crisis which we already visualized close upon us.

To summarize the results obtained, we will merely state that by the end of the fifth year of trials with these varieties, under almost every climatic condition conceivable for Tucuman (these fivo years including one more or less normal year, two exceedingly favourable and two record-breaking unfavourable seasons climatically), our average over the five-year period showed an annual yield of 9 tons of cane and about ¾ ton of sugar per acre for the "native" canes, whereas the P O J 213 had averaged about 30 tons of cane and 2½ of sugar and the P O J 36 about 26 tons of cane and 2¼ tons of sugar per acre. The P O J 234 showed an average under identical conditions of over 20 tons of cane per acre, its uniformly high sugar content under every condition causing its production of sugar to reach almost 2 tons per acre. For the three POJ varieties the average annual yield during these five years was 25 tons of cane and well over 2 of sugar—almost three times the yield of the Purple and Striped ! Besides the question of cultural yield, we had been able to prove definite superiority on each of the counts we had established as our points of needed superiority at the beginning of these investigations.

The time had come, therefore, for the Tucuman experiment station to make definite recommendations for supplanting the native Striped and Purple canes with the P O J varieties, and in 1915 an active propaganda was started by the writer to induce the planters to do so.

With the crop of 1915 a complete failure, many of the progressive planters of Tucuman at last put their prejudices and sentiments into their pockets and began to plant the new canes more vigorously, many of them paying enormous prices for their seed to the more enterprising and far-sighted men who had already established fairly large plantings of these more promising varieties. When in 1916 the average yield of the "native" canes dropped to only about 8 tons—(compare with Louisiana's 1926 yield)—the prejudices against these foreign invaders in their canefields almost entirely disappeared, and some 50,000 acres were laid down in the new canes, P O J 213 predominating. Some 60,000 acres more of the P O J canes were planted in 1917—about parallel to Louisiana's 1927 plantings.

In 1919 Tucuman produced the second largest crop in her history—over 246,000 tons—about 90 per cent. of this being made from P O J canes, although about 30 per cent. of her cane area was still in the "native" canes. By 1920 the latter had practically disappeared from commercial production, and it is an actual fact that to-day, when an occasional stalk of Purple or Striped cane is seen on a carrier in Tucuman, it is viewed with curiosity and interest—often by some of the very persons who a few years before had laughed at the idea of their places ever being taken by the much less aesthetic looking Java seedlings. In 1925 Tucuman produced 310,000 tons of sugar, a new record until the 1926 production of 375,000 tons. Such is the revolution wrought in this corner of the Argentine Republic by the use of the P O J canes.

An idea of the magnitude and expense of this reconstruction may be gained from the fact that the "Ingenio Santa Ana," then the largest sugar place in South America, the plantations of which the writer took charge of in 1916, had for the crop of 1916 some 15,000 acres of cane, not one stalk of which was of the P O J varieties. In his first two years on this estate these huge plantations were entirely renovated at a cost of over a million and a half dollars (£300,000), and for the crop of 1918 we did not have a single stalk of "native" cane !

A GLIMPSE OF LOUISIANA CONDITIONS TO-DAY.

It was the privilege of the writer two years ago to make several trips through a part of the sugar district of Southern Louisiana and the Louisiana canefields reminded him strongly of the condition of the Tucuman fields in the years 1915 and 1916, when the Striped and Purple canes had virtually "gone on strike," and when the Tucuman Experiment Station under his direction was bending every effort towards the rapid substitution of these by the then thoroughly tested P O J 36, 213 and 234. The native plant cane was coming up weak and yellow, with almost complete infection with mosaic disease, while the stubble in most cases looked absolutely pitiful to one who had known Louisiana in better days, with extremely scattered stooling and the typical yellow appearance so characteristic of a combination of drought and primary mosaic infection. At Southdown plantation where there were some hundreds of acres of P O J 234, the comparison with the old Tucuman conditions was particularly striking, for here the yellow colour of the fields in general would be crossed or spotted with dark green stripes or fields, looking like pasture land in the midst of the canefields. These invariably turned out to be either isolated rows or substantial fields of the P O J canes or of the mosaic-immune, but low sugar-content Cayana, growing vigorously and stooling heavily alongside of the anaemic-looking, sparsely-stooling D 74, Striped or Purple.

Of course the data obtained on any varieties under the peculiar conditions of one country can never be applied *in toto* to those of another, however similar it may be, for it has been the history of sugar cane varieties in general that a cane which has done very well in one country may turn out to be a complete failure under apparently similar conditions in another. D 1135 was considered to be a variety of no value whatsoever in Demerara, where it was produced by that veteran of seedling production, Sir JOHN HARRISON, but it is, nevertheless, the most popular cane in Queensland to-day, is very promising in parts of Porto Rico and its acreage is rapidly increasing year by year in the Hawaiian Islands, whereas D 74 and 95 never gave the results in the country of their birth that they did in Louisiana for many years. Examples of this sort could be cited *ad infinitum*. For this reason careful experimental work should always precede the changing of old tried varieties for new ones which may have shown wonderful results in another country, and, although it appears that Louisiana should at present multiply her P O J 234, 36 and 213 just as rapidly as it is possible for her to do so, in view of the crisis facing her industry, there are meanwhile being conducted carefully planned comparisons of these and other promising varieties in the distinct zones of her sugar section. We look upon the P O J 234, which she happens to have in comparative abundance, not as the final panacea of all her troubles and the final goal of her varietal changes, but as a cane which at least bids fair to maintain her industry while better and richer varieties are being sought for and thoroughly proved both by the individual planters and mill owners and by her Experiment Stations, State and Federal.

VISUALIZING THE FUTURE.

The past two years, however, have greatly added to our assurance of the adaptability of these canes to Louisiana conditions. In 1926 the limited extensions of the new canes, still growing mostly at Southdown, due to the vision and perseverance of Messrs. PIPES, KRUMBHAAR and JONES of the estate of H. C. MINOR, showed up in every respect very superior to even the

CONTRASTS BETWEEN OLD AND NEW CANES IN LOUISIANA.

FIG. 1.—Selected Louisiana Purple Cane in same Field as POJ 234 shown in Fig 2 Both Varieties were planted same day on Land of Identical Preparation, Cultivation and Fertilization throughout. Photographed 8th July, 1927.

FIG. 2.—POJ 234 Cane in same Field and under Identical Conditions as Louisiana Purple shown in Fig 1

best selected of the old canes. It will be recalled that the disastrous storm of 25th August, 1926, centred directly over Houma, where the larger supply of the new P O J cane for planting was located, on which supply the entire future of the local sugar industry hinged. This storm, however, but served to again emphasize the remarkable resistant qualitites of the new canes, for, whereas in the storm area the D 74 was so battered and broken that it yielded but three and a half to four tons of cane per acre at crop time, the P O J canes under the same conditions produced around 14 tons, and although the storm undoubtedly reduced our total seed supply some 40 per cent., sufficient seed was produced to lay down this past year fully 23,000 acres of the P O J canes.

Last winter also furnished abundant proof that the new canes are much more frost-resistant than the old ones, just as they proved to be in the Argentine, and in every mill test which we were able to make, with the limited amount of the new cane which we felt willing to divert from planting, the P O J cane showed up superior in analysis to the old canes under identical conditions, this difference working out at fifteen to twenty pounds additional sugar per ton of cane ground. During the growing season the writer has no hesitation in saying that never, even in the Argentine Republic, has he seen the P O J canes do so well as here in Louisiana. The difference between the new and the old canes is so apparent that even the casual visitor without any knowledge whatsoever of sugar cane frequently calls attention to the striking appearance of the P O J as compared with the D 74 or Purple canes growing under similar conditions. An idea of the difference in potential yield may be gleaned from some attempts the writer has recently made to determine the acre population of the two types of cane. This has been done by making a large number of counts in various sections of the State of average 100 ft. of rows to determine the number of millable stalks per lineal foot. The number of stalks per 100 ft. was then calculated to the 7200 lineal ft. per acre, which rows at 6 ft. apart give. With the old canes only the best Purple cane in the western section, where mosaic disease has not yet reached its maximum virulence, was counted, whereas the P O J canes of all conditions and of all varieties are included in the estimate. The average for these counts—and well over a hundred of them have been made—show that there are at present some 12,000 stalks per acre in the case of the Purple against an average of between 35,000 and 40,000 stalks for the P O J. This is amply illustrative of the comparative yields which may be expected at crop time from the two types of cane.

It was mentioned in the preceding paragraph that some 23,000 acres of P O J cane were planted last fall. While the recent floods destroyed around 33,000 acres of the old canes, the new canes have again demonstrated their very remarkable vitality by showing a loss from floods of only 1000 to 1500 acres, and, based on the present estimated yields, the remaining area of these new canes ought to produce sufficient cane to plant out the entire normal cane acreage of the State this fall and still leave 150,000 to 200,000 tons of cane for grinding.

Whether or not the normal acreage of cane can be planted down this fall, however, is going to depend entirely on the ability to finance such plantings. Until last fall few planters had been induced to go in for the new canes and, consequently, when a seed supply was available for planting the 23,000 acres already mentioned last fall, most of the planters were in such a bad condition financially that they were faced with the unfortunate situation of having a remedy for their troubles and yet being unable to pay for their medicine in

the shape of seed and cultivation costs of the new canes. This condition was realized last fall by the bankers, railway men and business men of New Orleans and the sugar district, and through them and some representative planters the State Agricultural Credit Corporation, Inc., was organized to finance the purchase of seed and the cultivation of the new canes in order to make the resuscitation of the Louisiana sugar industry more prompt and less painful. $325,000 was raised last year as the initial capital of the new Corporation, and this, when deposited with the Federal Intermediate Credit Bank of New Orleans, enabled the new Finance Corporation to finance about one-fourth of the present Louisiana cane crop. The capital of the Finance Corporation, however, is entirely tied up with the growing crop and if the requisite amount of fall planting is to be done an additional quarter of a million dollars capital must be raised immediately for the financing of the normal planting this year and the bringing to maturity of next year's crop. This is not a matter of merely academic interest, but one in which every man, woman and child in New Orleans and Southern Louisiana is more or less interested. The return of the Louisiana sugar industry to normal, and what we feel will be superior productive capacity than ever before, through the use of the new canes means an additional $40,000,000 or $50,000,000 per year to be spent in New Orleans and the surrounding territory, hence subscriptions are coming in rapidly from business interests only indirectly associated with the sugar industry. With a quarter of a million dollars of new capital there can be laid down in Louisiana this fall—and the new canes *must* be planted in the fall—practically a normal planting and all in the new P O J canes.

If this is done and the Louisiana planters show the same spirit of tenaciousness and progressiveness that they have shown in many other emergencies, the writer believes that they are justified in taking an optimistic view of the situation and that, justifying the faith and foresight of such of her pioneers as Dr. William Carter Stubbs and his associates of "the old guard which dies but never surrenders," Louisiana will experience a renaissance similar to that of distant Tucuman and will in the not very distant future once more be producing 300,000 ton sugar crops, once more have her factories all grinding for full seasons, and once again see the sugar industry at the forefront of the great contributors to the wealth and well-being of the old State.

In Germany soils likely to be deficient in phosphoric acid are examined by the *Azotobacter* test, in which a mixture of the sample with some calcium carbonate, mannite solution and nutrient salts is inoculated with *A. chrococum*. In the absence of a sufficient amount of phosphoric acid, this organism does not thrive in the medium, and from the appearance of the colonies one can obtain an indication of the richness of the soil in this element.[1]

Abbé H. Colin[2] does not think that it is possible by selection greatly to increase the sucrose content of the beet, seeing that it is doubtful if the plant could accommodate itself to the extremely high osmotic pressure required for contents say of about 27 per cent. But there are no such obstacles in the way of increasing the purity of the juice, and further of selection in the direction of improved keeping qualities. In regard to the first quality it would be interesting to select roots containing less ash (other important factors being equal); and, as to the second, it should be determined whether the quality of some roots of remaining healthy, whilst others in the silos suffer decomposition comparatively readily, is hereditary.

[1] A. H. Erdenbrocker: *Centr. Zuckerind.*, 1927, 35, No. 31, 885-888.
[2] *Sucrerie Belge*, 1927, No. 23.

Recent Work in Sugar Cane Agriculture.

Annual Report of the Agricultural Experiment Station in Tucuman for the Year 1926.

These reports and most of the results of the station's experimental work on sugar canes are published in the "Revista Industrial y Agricola de Tucuman," and are consequently in Spanish. The Director, W. E. Cross, has, however, forwarded a translation this year, and, although the Tucuman Station has quite recently received attention in this Journal, we are constrained to refer to it again, as progress appears to be somewhat rapid. And the first point to be noted is connected with its stabilization. Hitherto much of the work has been carried out on land rented year by year; and during the year under report 172 acres have been acquired to put an end to this hampering anomaly. The staff is also being strengthened; an additional chemist has been appointed, and agricultural and horticultural officers are to be added immediately. Houses are to be erected for the staff, and the various offices and laboratories rearranged and enlarged. Evidently, the good work which has been accomplished in this station has justified a considerable enlargement, which will cost a good deal of money.

Following the advice of the Director, a great extension in the planting of POJ 2725 is taking place; and the demand for seed cane was so keen during the year that the whole of the crop, 352,758 lbs., was distributed to the planters. The mixture of Rhodes grass and lucerne recommended for pastures has continued to be popular, and 10,450 lbs. of seed of the former and 85,658 lbs. of the latter, Alfalfa Inverneza No. 3, have also been distributed. The Government having prohibited the dumping of molasses and distillery waste into the rivers, a very thorough study has been made of the various modes of utilization of the waste products of the factories. But perhaps more significant than any of the above is the fact that data have been supplied by the factories as to the details of the sugar manufacture. It has been abundantly proved that the basal factor in a successful industry is co-operation, and this is especially the case with sugar manufacture; and the Director is to be congratulated on initiating the compilation of such information, after the example of Hawaii and Java—the surest sign both of the confidence which the Tucuman Agricultural Station has inspired, and the broad-mindedness of the managers of the various concerns.

Varieties of cane.—The following are considered at the present time to be the best suited to Argentine conditions, among the newer ones being tested: POJ 2725, POJ 2714, Tjepiring 24, S.N. 229 and 231; while some of the Tucuman seedlings are promising. POJ 2725 is stated to be almost immune to mosaic disease, and gives an excellent production of cane and sugar to the acre. It is, moreover, easy to strip and does not deteriorate rapidly after cutting, as is the case with POJ 36 and POJ 213, at present most largely grown. Various other Tucuman and POJ seedlings, and a number of Coimbatore seedlings are also in various stages of trial.

Mutations or sports are also receiving a good deal of attention. Shahjahanpur No. 10, imported four years ago from Australia, has turned out to be POJ 36, but appears to be more vigorous and a greater producer than this cane received from Java. Three colour mutations of this same variety are being tested—common, striped and purple—and the latter appears to be the most vigorous. Similarly, three forms of POJ 213 have been separated—purple, striped and white; and here again the purple appears to be the best. As there was no frost last winter, a number of varieties and Tucuman seedlings were allowed to stand over till the present year in

order to obtain flowers and seed from them, for raising new seedling varieties. There is obviously a considerable amount of important seedling work being done; and this is in the capable hands of G. L. FAWCETT, although under somewhat unfavourable conditions.

Methods of planting.—An important innovation appears to lie in the attempt to alter the time of planting the canes. This is generally in the winter, and entails certain disadvantages. It interferes with labour at harvest time, and if there are early frosts the seed cane is adversely affected. The sprouting of the young canes in the spring has also been found to be irregular and very tardy, thus causing much replanting to get a full stand. And the lateness of course also affects the yield and sucrose content of the canes adversely. If planted in early autumn (January to middle of March), on the other hand, there is no trouble about labour, and the canes sprout immediately and grow well before winter sets in. The young canes have to be protected from frosts, however, and this protection has been found to be provided by throwing earth on to the stools in late autumn; if the leaves are frozen, they are left untouched until the end of August and then simply chopped away. The results of using this time for planting have been so satisfactory during the past three seasons on the station and in certain plantations, that it appears to be likely that several thousand acres will be treated in this way for the next season. Planting in holes in place of furrows appears to continue to give favourable results.

POJ 36 and 213 differ a good deal in habit, the former being erect while the latter is frequently blown down. And, to overcome this difficulty, the ingenious idea of mixing them in the plantations has been put into practice, so that the erect canes may provide a support for the sprawling ones. The two kinds were accordingly planted in alternate rows, but this proved to be only a partial success, for the POJ 213 canes were without support when winds blew down the rows. The experiment is now being tried of alternating them in the rows themselves. The results will probably afford interesting reading, both as regards the stand of cane and as affording a complete method of comparing these two varieties in almost every respect.

Methods of cultivation.– The use of agricultural machinery in place of the usual spade work has been tested on the station for years past; and the planters appear at last to be moving in this direction, equal results being claimed "at a fraction of the cost of the old method." Protection of early cut cane during the following winter has received much attention during the past six years: "the pernicious effect of early cutting may be largely avoided by covering the stubble with earth by a disc cultivator, until the spring." Crop rotation, it is pleasant to learn, is being adopted by an increasing number of planters. Lucerne is the best if two years can be spared; while for a one-year rotation "cow peas in summer, and hairy vetch, No. 9 clover and beans in winter, have given the best results" ECKHART's Hawaiian method of covering the canes before sprouting, whether plant or stubble, with tarred paper, is said to have given quite positive results; the sprouting was accelerated and greater production of canes and sugar was obtained.

Manurial experiments.—The use of stable manure, as usual, fully justified itself, both in increased production and in regeneration of the soil. Soluble nitrogenous fertilizers, applied both in station plots and on estates to POJ 36, on three or more years' ratoons, gave increased yields both in cane and sugar per acre; but the sugar content of the canes was always lower than on un-

treated fields. Once the present crisis is past, it may be expected that the managers of estates will turn their attention to high cultivation of the land near the factories, instead of producing inferior yields a long distance away.

Interesting results have been obtained in continuing the experiments on the use of phosphates together with soluble nitrogenous fertilizers. The results have again shown that the phosphates have no effect on either the tonnage or sugar content of the cane; and do not prevent the reduction of the latter which usually follows the use of nitrogenous fertilizers. Thus "they are in entire disagreement with the theory generally accepted in the sugar world, that the reduction in sugar content produced by nitrogenous fertilizers is counteracted by the action of phosphoric acid." Various results obtained on the station on the application of manures have been published in the Station "Revista." For instance, the application of 222-263 lbs. of sulphur per acre gave an increase of 2220-2850 lbs. of cane and an increase of 222-263 lbs. of sugar on an average of three years' experiments. The experiment with lime, conducted for seven years, has been brought to a close: in spite of quite large applications, the results were completely negative. And similar experiments made with phosphates gave the same result.

Short reports are appended of the work in the Botanical and Pathological Department by G. L. FAWCETT and in the Chemical by A. S. ALVAREZ. The former has observed that during the past two winters white horizontal stripes, rare and therefore very striking, have been met with on the cane leaves; and these have been traced to the effect of low temperatures on the young and tender portions of the leaves at the base. Experiments with barrels in a large refrigerator showed that temperatures of 32° F. to 44·6° F. or 46·4° F. were sufficient to produce these chlorotic stripes. Generally speaking, these appearances are not in evidence in Tucuman, because the cane is usually so damaged in winter by frost that the shoots do not grow, and the new leaves remain folded in their sheaths.[1] Another leaf injury termed "polvorillo rojo" calls for attention as being brought about by mealybugs. The lower leaf sheaths and sometimes the upper ones as well, become red; and this result is brought about by the fermentation of the sweet exudation of these insects. It is especially common from March to June, when the rainfall is low; but after this period the rain washes the gums and acids away and the damage is reduced.

A COMMITTEE REPORT ON THE DISTRIBUTION OF SUGAR CANE ROOTS IN THE SOIL. *Association of Hawaiian Sugar Technologists. Sixth Annual Meeting, October,* 1927.

This subject was referred to in a recent number of this Journal,[2] in which an interesting piece of work by H. ATHERTON LEE, the Chairman of the Committee was described. Two methods were detailed by which the root distribution in the different layers of the soil was estimated, namely, one by growing the cane plants in boxes under artificial conditions, and another by the selection and study of plants growing in the field. Briefly recapitulating, in the first method one-budded sets were grown in 30-in. cube boxes with removable sides, and fitted with shelves of coarse wire netting inserted at different heights in the filled in soil; at the end of the experiment, the sides of the box being removed, this soil was washed out, leaving the root system entangled and held in place by the wire. All the roots were cut off between the different layers of netting, commencing with the lowest, washed and air

[1] *See I.S.J.*, 1927, 198, for a similar observation in Cuba.
[2] *I.S.J.*, 1927, 363-366.

FIG. 1. Showing the type of root study boxes used in the earlier work on this subject; from a wooden frame horizontally placed wire netting is stretched at different levels. Wooden sides screw on these frames and the boxes thus formed are filled with earth. After growing cane in the earth the sides of the boxes are removed and the earth washed away, leaving the roots suspended on the wire netting, as shown above, available for study.

FIG. 2. Showing one of the root-study boxes after the sides have been removed and the soil washed away from the roots of the cane plant. The seed piece is seen lying on the top wire netting with one end pointing toward the observer. The eye on the seed piece, which has by this time developed into several shoots, was pointing to the left when planted. A very large percentage of the roots developing from these shoots have grown downward and toward the left side of the box. Very few roots have grown toward the right side of the box.

dried, and then weighed. By the second method, batches of five contiguous typical plants were selected in the field, cut level with the ground and separated from the rest of the field by an enclosure of planks, and the soil dug out successively to different depths. All the roots in each layer were kept separate and treated as before, and their dry weights recorded layer by layer.

As appears to be usual, this paper of LEE's, originally written for "Plant Physiology," is reprinted in the Report in full, with an added picture of the box method, which is so good that it is here reproduced (see Plate, Fig. 1). Three other papers are added, showing that this work on root distribution is proceeding rapidly. In the first of these LEE and WELLER discuss the "Progress of the Roots at different Ages in Growth." The box method was employed, and 15 one-bud sets were grown in separate boxes. At the end of each month, three of the boxes were opened and the root systems examined, and the experiment thus lasted during five months' growth. In each case the weight of roots was determined in 8 in. layers down to 2 ft., and the remaining layer of 6 in. was added (although it appears to the writer quite possible that the roots below 2 ft. were not encouraged to develop properly because of their cramped surroundings).

Using the method adopted in our former article,[1] the following figures may be sufficient to indicate the character of the results; first giving the total weight of roots developed during each month, and then the percentages of this total by weight in each layer from the top downwards.

Results. First month : 1·32 grms. roots ; 86, 12, 1·9, 0·3.
Second month : 17·5 grms. roots ; 75, 17, 5·3, 1·9.
Third month : 151 grms. roots ; 65, 19, 9·3, 6·1.
Fourth month : 251 grms. roots ; 60, 19, 11, 9·5.
Fifth month : 334 grms. roots ; 69, 18, 8, 5·2.

It is seen from these figures that the proportion of roots in the topmost 8 in. decreased during the first four months, after which a fairly constant percentage was found there ; and a corresponding increase and further constancy may be noted in the roots recovered from the lowest layer. (It appears to the writer that *these* figures rather show that this change occurred in the third month ; and there is still the question as to whether the lowest layer was normal for root development).

The second paper printed by the Root Distribution Committee is one by D. M. WELLER, in which he describes an "Interesting Habit of Sugar Cane Roots." This habit was observed on two previous occasions, and appeared to be worthy of a separate test, especially as it promised to interfere with the study of the tropism of the cane roots towards a fertilizer placed at a certain depth in the box. The observations indicated that there was a tendency for the roots to be influenced in their line of growth by the direction which the bud on the set faced when planted. Experiments on the tropism of roots towards fertilizer were made with 16 boxes as already described. Four of these were simply filled with earth and acted as controls ; four had nitrate of soda added, four sulphate of potash and four superphosphate, in each case the fertilizer being contained in a flat cheesecloth bag, sunk to a depth of 16 ins. from the surface, and each bag of such a size that it exactly covered one-half of the superficial area of the box, at that depth. Each box might, thus, be considered to have one-half fertilized and one-half unfertilized, and it was intended to note whether the roots tended to congregate in the fertilized half.

[1] See *I.S.J.*, *ibid.*

The experiment was, however, complicated by trying, at the same time, to find out whether the position of the bud had any influence on the result. For this purpose, the boxes with fertilizer in them were divided into four groups, each of which included one control, and one each with nitrogen, potash and phosphoric acid; and each group was used to test the facing of the bud in a different direction. The sets were, as usual, placed flat on the surface of the soil, with the bud facing laterally and not vertically upwards or downwards; taking the line of division between the fertilized and unfertilized halves of the boxes as lying north and south, the buds were placed facing W, E, S, and N; and in all cases the bud was placed exactly in the centre of the box surface.

At the end of each month four boxes were removed and examined; one control and one with each fertilizer used. The weight of the roots was determined in each half of those boxes which had fertilizer, and the weights compared. Unfortunately the results are only given of ten of the twelve boxes examined, which prevents a full analysis of the results. But, all the same, the figures given seem to afford a somewhat striking confirmation of the previous observation. In the three cases in which a bud faced the unfertilized half of the box, the weight of roots was greater in that half than in the half which had been fertilized, and in fact was two or three times as great. One of these three was in a nitrogen box, while the others were in potash and phosphoric acid boxes. In the seven boxes, where the bud did not directly face towards the unfertilized half, a difference in weights of root was observed in favour of the fertilized half, though varying from four times as great to only a slight amount.

The conclusion, which is well illustrated by a photograph (see Plate, Fig. 2) of a previously observed case, is that "the majority of the roots of the cane plant spread in the soil in the direction which the eye faces"; and the author points out that "in order to study the influence of fertilizers on roots, the influence of the position of the bud on the seed piece must be first eliminated. This is being attempted in an examination under way."

Pending the results of this enquiry, which will probably lead to a very simple solution, the writer makes one suggestion. While the embryo roots of the root zone of the set, adjoining the germinating bud, have a comparatively short life, the new plantlet is in all probability primarily dependent for its growth on the stronger and later ones developed at the base of its own newly-developed leaves. And as, for a considerable time, these latter roots are prevented from growing towards the fertilized half of the box by the comparatively large bulk of the set, they will naturally point their direction away from this obstruction, and grow obliquely downwards into the free earth offered to them; there is no reason why they should grow round the surface of the set to get at the earth below it or on the other side of it. They will, thus, continue to spread out in this direction, at the same time gradually getting further from the possible influence of the deep bag of fertilized earth. The experiment was too short and the distance too great for the tropic influence to have effect in such a case. The proper position of the bud in an experiment conducted on these lines will be a matter for trial. But placing the set along the east and west line, i.e., across the line of division between the fertilized and unfertilized halves, whether the bud faces north or south, would appear to be the easiest method of elimination.

The last paper printed by the Committee on the Distribution of roots in the Soil is entitled "Why Root Studies?" and is written by W. P. ALEXANDER, a well known irrigation expert; it is very short and is reproduced

below in full. The details which are accumulating in these studies in Hawaii are extremely interesting. But it must be remembered that it is probable that the results from similar experiments carried on in any other country might be very different ; because both in irrigation and soil character Hawaii is unique. Thus, the value of these researches, for the cane industry in general, will probably be found more in a study of the methods adopted than in the conclusions arrived at. Similar studies are now especially needed in countries where irrigation is not present ; for there is little doubt that the mere practice of irrigation will materially affect the zoning of the sugar cane root system in the ground. It is highly probable, for instance, that the extreme concentration of the roots in the surface layers will not be met with where irrigation is not practised. And, indeed, some of ALEXANDER'S remarks should be read with this in mind ; namely, there is rather a tendency to regard the results thus far obtained as those due to a reaction between the soil and the plant. Whereas, the relative concentration of the roots in special layers may very well turn out to be a matter which can be altered by judicious treatment, whether by variations in irrigation or not ; and it would be a fitting subject for research to determine whether the present arrangement of the cane roots in any place is the best for the main aim of industry—to obtain as much sugar as possible from the land through the sugar cane. In some places this aim may be attained by increasing the amount of irrigation, while in others the reverse may be the case ; and it is probable that any such change will be accompanied by a concurrent re-distribution of the layers of root concentration.

The following is ALEXANDER'S paper : "The plantation man finds the root studies made by H. ATHERTON LEE, of the Experiment Station, H.S.P.A., to have a direct bearing on some of the agricultural problems which he must solve.

"If sugar cane is a surface feeder, as was demonstrated, plantation practice of irrigation, fertilization and cultivation must be adjusted to this fact. The accumulation of the largest mass of roots within 2 ft. of the surface suggests that it is advisable to conform field procedure so that the cane will have the best growing conditions.

"This technique of determining the amount and distribution of the roots under different soil and cultural conditions can be employed to answer specific questions arising from agricultural research. The factor of root development is fundamental in the study of any growth of cane, especially if it is abnormal. First, therefore, root studies, as outlined by LEE, should be made of all diseased cane. Mere inspection of roots should not be enough, but a careful examination of their depth and distribution will supply data that will indicate the proper line of control necessary to prevent or check the ailment. If there is a healthy and normal root system, then other causes must be looked for in subnormal growth.

"The subject of hilling up cane is quite controversial. The report of LEE'S throws new light on this practice and shows that further study should demonstrate where hilling up will be profitable or otherwise. So, also, other cultural practices have in recent years been criticized as merely useful as means of weed control. Certainly with at least 58 per cent. of the roots in the first 8 in. level, extreme care must be exercised as regards cultivation, which is apt to be root pruning and also which will disturb natural growth of roots. The problem which is more important—aeration or undisturbed root development—can be watched in such root studies.

"How many ratoons can be raised? Is it necessary to plant? The application of root studies should assist in the answer of these questions, which depends to some extent on the quantity and distribution of the roots. Certainly areas where the root system of the ratoons is depleted, as shown by such tests as undertaken by LEE, would profit by ploughing and planting. On the other hand, a most vigorous, well-distributed root system would show that future ratoons could be raised with more profit. In some districts, the inability to obtain many ratoon crops is a field for investigation. Reasons for the failure to secure second and third ratoons may be found by root studies, and perhaps the proper corrective measures can be taken.

"The root zone has been shown to be very limited. Irrigation and fertilizer that pass below the layer of roots are lost. It behoves everyone, therefore, to heed the lesson learned from such root studies as these and apply water and plant food so that there is as little waste as possible. In soil moisture determinations and soil analysis it will be rational to concentrate then on that belt where the greatest proportion of the roots occurs, and by taking more samples in the first 2 ft. area, rather than spreading the work over a greater range in depths of soil outside of the root zone.

"Irrigation of fields where root studies show mostly shallow roots must be made frequently as the surface soil dries out quickly. On the other hand, a deep-rooted field will be able to stand up better under drought conditions, and therefore may be given irrigation at longer intervals during periods of water shortage. A survey of the root penetration under different soil types and canes of different ages and varieties would serve the irrigation overseer in the proper distribution of his available water.

"Plantation practice should emphasize the need of securing cane plants with the deepest root systems possible. Root studies may show what conditions of ploughing, fertilizing and irrigation favour the extension of well developed roots that are not mere surface feeders. If root growth can be promoted in the lower depths our ratoons will be more stable, more natural plant food will become available to the plant, and moisture conditions for the cane will be more constant. Results from root studies will indicate the best practice to follow in order to treat our cane plant so that the greatest and deepest root development will take place. Large cane yields are absolutely dependent on the right foundation of roots that are healthy and are expanded to the greatest extent. Let us increase our knowlege of the growth of the roots and follow up the good beginning made by LEE. It is a worthwhile project."

C. A. B.

"The ideal means of disposal of this waste product (molasses) is to convert it into alcohol and motor fuel. By this means all automobiles, track motors and trucks belonging to the central can be operated without purchasing gasoline, and the greater part of the cane hauling can be done by alcohol-burning internal combustion locomotives.[1] . . . . . A factory milling 2000 tons (metric) of cane daily will produce in the neighbourhood of 10,000 gallons (U.S.A.) of molasses which, if manufactured into motor fuel, will return to the central around 800 gallons of this product per day. With this amount of good fuel available, many centrals having fairly compact transportation systems can haul every ton of their cane to the mill and all their sugar to the point of shipment without burning a lb. of coal . . . For the planter, cultivation costs can be reduced very materially by the use of motor alcohol in his tractors; the alcohol or motor fuel he receives for his share of the molasses produced is "pure velvet," and practically all his ploughing can be done with motor alcohol, which works satisfactorily in all makes of tractors (excepting those designed especially for the use of kerosene)."

[1] H. I. SHOEMAKER in *Sugar News*, 1927, 8, No. 9, 677.

Application of the Zeiss Pan Refractometer for controlling Massecuite Boiling.

By J. A. KUCHARENKO, Prof. A. K. KARTASHOV, and B. G. SAVINOV,
Sugar Experiment Station, Kiev, Ukraine.

One of us in 1920 when discussing the question of controlling the boiling station[1] stated : "In order to solve the problem of continuous crystallization in sugar manufacture, one must invent a device for the direct, accurate and instantaneous determination of the co-efficient of super-saturation of the mother-liquor during boiling in the vacuum pan. Hence the problem for our opticians is to transform the refractometer to the determination of the sucrose content of the mother-liquor directly in the pan."

Some years afterwards the firm of Carl Zeiss (in Germany) constructed an industrial refractometer satisfying modern manufacturing requirements in regard to massecuite control. This instrument provides the possibility of determining the solid contents of the mother-liquor at any moment, and without sampling it.

It consists of two parts ; the optical part with the prism is inserted into the pan, and is fixed on special frames, while the measuring part is connected to the optical part by means of special joints. Thus, having each pan provided with an optical part, set in the wall of each, only one measuring part is required, this being transferred from one pan to another.

In Fig. 1 is shown the design, installation and use of the refractometer. Light from a lamp reflecting from the mirror *R* falls on the prism *P*. One side (*B*) of the prism *P* touches the boiling product, and light is thus reflected from the surface of the mother-liquor, the angle of reflection depending on the density of the liquor. Sugar crystals adhering to the surface *B* do not influence the reflection of these rays. Mirror *C* throws the reflected rays of light through the protecting glasses *S*, and S^1 into the measuring part of the refractometer. By using the screw *T*, one can adjust a correction on the special scale for the temperature inside the pan, this being determined by a mercury thermometer placed near the refractometer. Screw *F* serves for making the reading, which will then give the content of solids in the mother-liquor corrected to normal temperature. The accuracy is 0·2-0·3 per cent. Prism *P* is provided with a plate *W*, operated by the handle *H*, this plate closing the prism when observations are not being made and also removing crystals adhering to the surface of the prism. It has a channel with holes, through which using the tube *Z* one can draw some hot water for washing the surface in case the great quantity of adhering crystals hinders the reading.

During the 1926-27 campaign the refractometer operating on these lines, acquired by the sugar experiment station, Kiev, Ukraine, was tested and at the Derugino experimental factory. It was applied to the boiling of refinery massecuite, which requires a particularly rapid control, the whole process being quickly completed. This instrument was installed on the same level as the proof-stick. During all experiments, boiling was effected with the introduction of artificial crystalline centres and with continuous draught.

Firstly, the experiments had for their purpose the collection of data characterizing the course of boiling, based usually on empyrical data. During the whole range of boiling the readings of refractometer, thermometer and vacuummeter were observed ; graphs of percentage solids, temperature of the

[1] Prof. J. A. Kucharenko. Some principles of designing continuous vacuum pans. Vistnik Cukrovoi Promislovosti, Kiev, 1920.

massecuite, vacuum and co-efficient of over-saturation were constructed with the data obtained.

All the graphs were super-imposed, enabling one thus to see the average variation of the factors named. Correcting the graph based on theoretical suppositions we have obtained one which we have called the "ideal boiling graph" (Fig. 2).

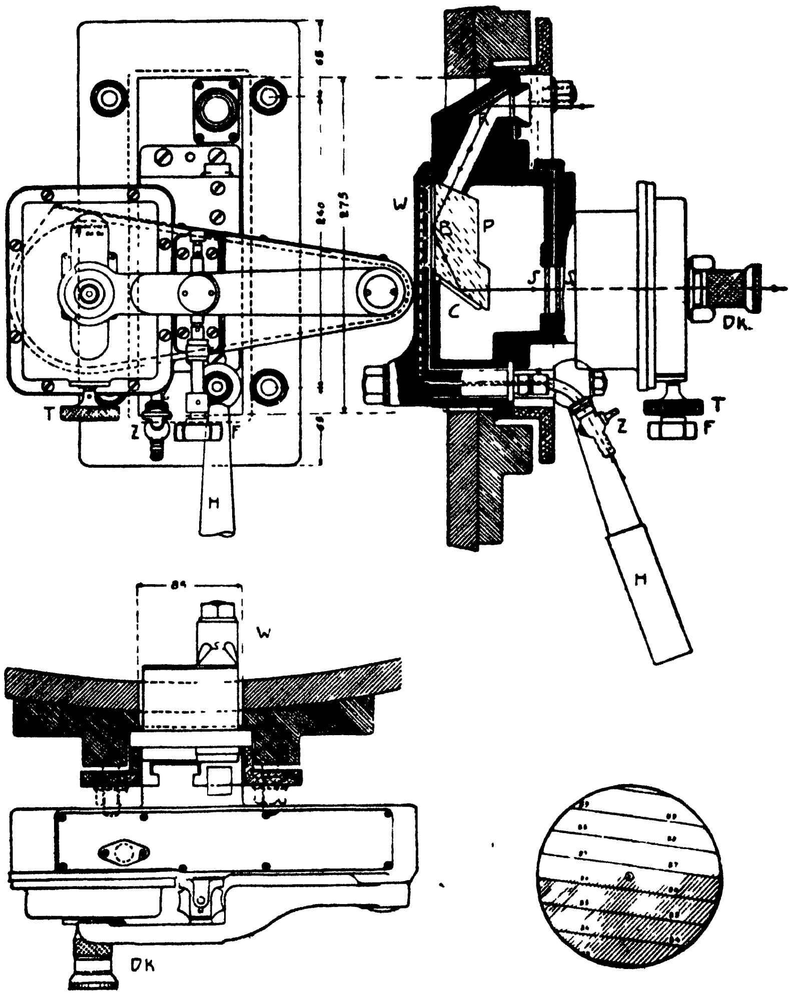


FIG. 1.

Zeiss Pan Refractometer.

Another object of our experiments was to conduct boiling on a basis of the "ideal graph." The time for the addition of the seed, the moment at which the draught was begun and the intensity of the latter during boiling were recorded by refractometric observations. In such a manner a great number of boilings were completed. But here the data of one only of these are given with the corresponding graph (Fig. 3), which indicates the vacuum

curve, curve for the temperature change of massecuite, curve for the mother-liquor solids determined with refractometer, and curve for the co-efficient of super-saturation.

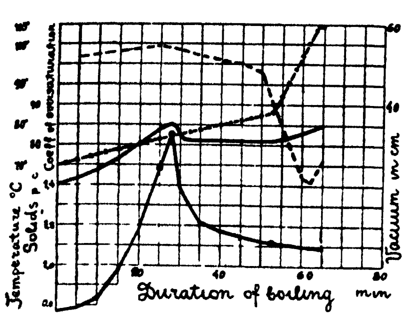


FIG. 2.
"Ideal Graph."

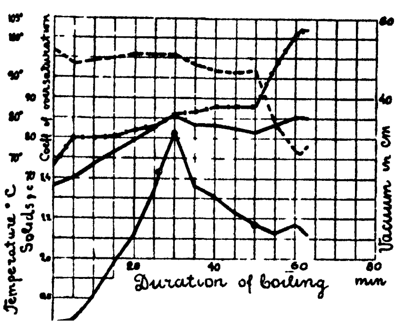


FIG 3.
Graph of 348th Pan.

Curve 1 (from bottom) relates to the coefficient of supersaturation;
„ 2 to the refractometric dry substance;
„ 3 to the temperature;
„ 4 to the vacuum.

By comparison of the various boilings and their graphs (the remainder of which are not reproduced here) with the "ideal boiling graph," one can observe the degree of accuracy of different workmen controlling the boiling of refinery massecuite. In the beginning the graphs obtained have the same character but slightly decline from the ideal when nearing their limits. These are to be explained by changes of the steam pressure, syrup density, and condenser operation. But they do not reduce at all the value of the refractometer as a means of control.

TABLE I.
(348th pan.)

Time, hours	min.	Vacuum in cm.	Temperature. °C.	Mother-liquor Solids.	Coefficient of Super-saturation of Mother-liquor.
2	35	52·00	68·00	68·00	0·68
2	40	48·50	75·00	70·00	0·69
2	45	49·50	75·00	73·40	0·81
2	50	50·00	75·50	76·30	0·98
2	55	50·50	77·00	79·60	1·12
3	00	51·00	78·00	82·50	1·34
3	01	51·00	78·50	83·50	1·43
3	05	51·00	81·00	85·60	1·62
3	10	48·50	81·50	83·40	1·36
3	15	47·00	83·00	83·20	1·31
3	20	46·50	83·00	82·20	1·23
3	25	47·00	83·00	81·50	1·17
3	30	33·50	93·50	83·30	1·13
3	35	27·00	101·00	85·50	1·17
3	35	26·00	101·50	85·30	1·16
3	36	—	102·00	85·20	1·14
3	38	28·00	102·00	85·00	1·12

Remarks: Seed added at 3 h. 01 min.; draught began at 3 h. 05 min.; and draught finished at 3 h. 25 mins.

Having established these data a more serious experiment was attempted, viz., to execute a boiling by following the refractometer readings without observing a sight-glass, and without touching a proof-stick. Such a boiling was accomplished up to the last minute of the heating period, and only on

finishing has one to follow empyrical signs, due to the fact that refractometer readings may not give an average idea of the process.

We predict that the use of the *Zeiss* pan refractometer for controlling the boiling and management of low-grade refinery massecuite will present the same favourable results seeing that the boiling process of these massecuites proceeds more slowly than that of higher grade refinery massecuite.

Hence, in conclusion we may say: (1) The *Zeiss* pan refractometer is now the best device for controlling boiling, as it presents the possibility of a picture of the course of the process at any moment, this permitting one, in fact, to manage the boiling process on a scientific basis; (2) by means of this instrument every factory may work out an "ideal boiling graph" for every product, thus standardizing the method of boiling, which will produce the best results; (3) it also opens up the possibility of an inexperienced workman realizing the same good results as an experienced operator; (4) taking into consideration what has been said, it would appear to follow that the *Zeiss* pan refractometer should come into wide use in all factories, proving as indispensable in the factory as a polarimeter is in the laboratory.

Factors in Milling.[1]

By J. LEWIS RENTON.

In preparing a paper on the relation of hydraulic pressure, maceration, and the number of mills in a train to the extraction, the first step to take was to divide the test into its three parts and test for extraction, varying in turn the hydraulic weights, the maceration, and the number of mills in use. This had to be done with no delay to operation, and with as little loss as possible. To obtain comparable results, all the factors entering into the test should be uniform. For instance, in varying the hydraulic weights, unless the dilution, tons cane per hour, and quality of cane remain the same, these variables could easily affect the results more than the varying of the weights. As soon as this was apparent, steps were taken to repeat as many runs as possible.

TEST NO. 1.—VARYING HYDRAULIC WEIGHTS.

It was deemed advisable in this experiment not to vary the hydraulic weights of the crusher (the men having learnt to keep the crusher full), the tons of cane fed per hour thus remaining practically constant for any one run. It was felt more important to keep the tons of cane ground per hour constant than to vary the hydraulic weights on the crusher. The tests then consisted of three runs, starting with what was considered the Ewa standard, or as the mills are actually operated, making three reductions of 50 tons each, the mill running an hour on each reduction while taking the necessary observations and the necessary samples. We were not able to go above "standard," as, with our tonnage and settlings, the mills cannot take more without speeding them up.

At first the runs seemed fairly representative, as the tabulations show, but on plotting the extraction and horsepower consumed against the hydraulic weights, it is quite apparent that three runs were quite insufficient for any practical purpose. The first run was not plotted at all, as there were variations in quality and quantity of cane which changed from hour to hour, which influenced the figures out of all proportion to the change in weights.

[1] From Reports of the Hawaiian Sugar Technologists' Association, 1927; here abridged.

Two other curves showed corresponding tendencies, the variable here being the tons of gross cane ground per hour, which was about 82 for Run No. 2 and 90 for Run No. 3. There were three points directly in line in each of the curves plotting extraction against the hydraulic weights, and if this is taken as any indication, it may be that one will vary directly with the other. The indicated horse-power curves showed a fairly definite tendency.

TEST No. 2.—VARYING AMOUNT OF MACERATION.

Here again the plotting of figures on paper showed up plainly the uselessness of a few runs in determining any definite trend or relation between the amount of maceration and the other data. The maceration was controlled by a flow meter in the maceration line, and while the meter figures did not check very closely with the computed dilution, still it was a great aid in controlling a uniform application for any particular run by maintaining the indicating needle at a particular predetermined point. This test consisted of two runs with a varying dilution.

TEST No. 3.—VARYING NUMBER OF MILLS IN TRAIN.

Here again it is clearly demonstrated that only by a vast number of tests can any reliable data be collected. This test consisted of two runs varying the number of mills in the train. This was accomplished by letting all subsequent mills to those being tested run idle. The tons cane (gross) ground per hour was 88 in Run No. 1 and 92 in Run No. 2.

Mr. WALTER E. SMITH, of the Experiment Station, who was present during the run, suggested that it might be possible to better the milling results by running the sixth mill all the time as a bagasse dryer, adding all maceration water ahead of the fifth mill. He stated that he knew of one case where the fourth mill (the last set of a 12-roller mill train) had been used in this fashion, and that for this one test run there had been no loss in extraction, and a very much better fuel obtained. Two runs were conducted by him at Ewa, but both runs failed to equal the results of our usual procedure. While making the 15-roller mill runs in the test under discussion, samples were taken concurrently back of the sixth mill, and the tabulations labelled "15-roller Special." It is apparent that the drier bagasse and loss in extraction does not warrant adopting this practice here.

This test, however, does not condemn further experimenting along this line. From a purely theoretical standpoint, the reduction of the sucrose lost in bagasse can be considered as being effected by six different factors: (1) Dilution; (2) pressure applied; (3) number of pressure applications; (4) amount of time bagasse blanket is under pressure; (5) thickness of blanket; and (6) quality of the cane.

If a 4-mill train can employ the last mill as a dryer to advantage, and a 6-mill train cannot, it would indicate that different factors control the sucrose lost in the bagasse. Where a 6-mill train has a thick blanket and the bagasse is under pressure a short time, the opposite is inherently true of a shorter mill train. The effectiveness of the last mill in a 4-train is, therefore, much greater than the last mill of a 6-mill train. I believe the thickness of the blanket is a factor, as much of the moisture or juice in a thin blanket grinding slowly has time and opportunity to flow out of the blanket and find its way to the juice pan, whereas a thick blanket moving fast may not only present time insufficient for voiding itself, but may actually contain pockets of juice and carry these on through the milling process.

TEST No. 1.

VARYING HYDRAULIC WEIGHTS.

Run No. 1—May 24th, 1927. Crusher Hydraulic Pressure 353 Tons.

Time	"A" Engine. I.H.P.	"A" Engine. R.P.M.	"B" Engine. I.H.P.	"B" Engine. R.P.M.	Total I.H.P.	Hydraulic Pressure, Tons. 1	2	3	4	5	6	Tons Cane per Hour.	Extraction.
10 : 05	497·50	44	465·10	52	962·60	438	438	462	344	396	502	87	98·16
11 : 05	499·10	45	468·10	55	967·10	389	389	413	293	346	449	82	98·13
1 : 00	514·90	46	389·00	55	903·90	340	340	365	242	297	396	82	98·06
2 : 25	490·30	47	369·20	55	859·50	292	292	316	191	247	343	88	97·83

Run No. 2—May 26th, 1927.

Time	"A" Engine. I.H.P.	"A" Engine. R.P.M.	"B" Engine. I.H.P.	"B" Engine. R.P.M.	Total I.H.P.	Hydraulic Pressure, Tons. 1	2	3	4	5	6	Tons Cane per Hour.	Extraction.
9 : 00	512·70	44	510·70	56	1023·40	438	438	462	344	420	515	80	98·38
9 : 50	491·70	44	452·20	56	943·90	389	389	413	293	371	462	82	98·12
10 : 20	428·30	44	397·60	53	825·90	340	340	365	242	321	409	82	98·06
10 : 55	409·00	45	325·30	51	734·30	292	292	316	191	272	356	84	97·63

Run No. 3—May 28th, 1927.

Time	"A" Engine. I.H.P.	"A" Engine. R.P.M.	"B" Engine. I.H.P.	"B" Engine. R.P.M.	Total I.H.P.	Hydraulic Pressure, Tons. 1	2	3	4	5	6	Tons Cane per Hour.	Extraction.
8 : 45	543·60	50	584·70	60	1128·30	438	438	462	344	433	502	95	97·90
9 : 45	526·40	50	458·90	53	985·30	389	389	413	293	383	449	90	97·63
10 : 25	476·50	50	381·40	54	857·90	340	340	365	242	334	396	85	97·52
10 : 50	462·60	50	370·70	53	833·30	292	292	316	191	284	343	90	97·32

Test No. 2.—Run No. 1—June 8th, 1927; Java Ratio, 85·00; Normal Juice Factor, 96·20.

Brix Crusher Juice.	Purity Crusher Juice.	Brix Mixed Juice.	Brix Last Expressed Juice.	Purity Last Expressed Juice.	Per cent. Sucrose Bagasse.	Per cent. Moisture Bagasse.	Per cent. Fibre Bagasse.	Per cent. Sucrose Cane.	Extraction.	Dilution Per Cent. Normal Juice.
19·60	89·30	18·00	5·70	53·70	2·60	40·40	54·76	14·88	96·44	4·72
20·20	88·10	16·90	3·60	66·70	1·90	42·80	54·35	15·13	97·42	14·90
19·30	88·10	14·90	2·30	69·60	1·40	42·80	55·19	14·45	98·04	24·63
19·50	88·20	14·40	2·00	65·00	1·20	43·20	54·95	14·62	98·33	30·28

Run No. 2—June 10th, 1927; Java Ratio, 84·78; Normal Juice Factor, 97·00.

Brix Crusher Juice.	Purity Crusher Juice.	Brix Mixed Juice.	Brix Last Expressed Juice.	Purity Last Expressed Juice.	Per cent. Sucrose Bagasse.	Per cent. Moisture Bagasse.	Per cent. Fibre Bagasse.	Per cent. Sucrose Cane.	Extraction.	Dilution Per Cent. Normal Juice.
18·40	88·10	16·50	3·86	69·20	1·70	41·20	56·34	13·73	97·36	8·00
18·20	87·40	15·30	2·20	67·70	1·40	41·00	56·93	13·48	97·81	15·36
18·20	87·90	14·60	2·16	67·60	1·10	42·80	57·07	13·56	98·30	20·09
17·80	83·10	12·70	1·76	60·80	1·00	43·00	55·35	12·55	98·47	35·99

Test No. 3.—Run No. 1—June 22nd, 1927; T.C.H., 88.

Number of Rolls.	Crusher Juice.			Purity Last Expressed Juice.	Per cent. Sucrose Bagasse.	Per cent. Moisture Bagasse.	Per cent. Fibre Bagasse.	Per cent. Sucrose Cane.	Per cent. Sucrose Lost Bagasse.	Extraction.	Dilution per Cent Normal.
	Brix.	Polarization.	Purity.								
18	18·80	16·20	86·30	62·50	1·10	42·80	55·44	13·45	0·231	98·28	31·75
15	17·00	14·40	84·70	75·00	1·70	42·00	55·73	11·95	0·355	97·03	30·05
12	17·10	14·30	83·60	66·50	2·00	45·20	51·79	11·87	0·450	96·21	25·35
9	17·60	16·10	86·60	77·30	3·00	40·40	55 67	13·36	0·628	95·30	36·34
15-roller special mill					1·80	38·00	59·12	11·95	0·355	97·03	—

Run No. 2—June 23rd, 1927; T.C.H., 92.

Number of Rolls.	Crusher Juice.			Purity Last Expressed Juice.	Per cent. Sucrose Bagasse.	Per cent. Moisture Bagasse.	Per cent. Fibre Bagasse.	Per cent. Sucrose Cane.	Per cent. Sucrose Lost Bagasse.	Extraction.	Dilution per Cent Normal.
	Brix.	Polarization.	Purity.								
18	18·70	16·00	85·60	66·90	1·10	43·80	54·56	13·28	0·23	98·27	26·41
15	17·10	14·30	83·60	64·10	1·50	41·00	56·66	11·87	0·30	97·47	26·31
12	17·30	14·30	82·70	70·20	2·20	50·20	46·67	11·87	0·54	95·45	27·77
9	18·70	15·40	82·40	71·60	3·40	43·40	51·86	12·78	0·75	94·13	30·08
15-roller mill special					1·50	37·20	60·46	11·87	0·29	97·56	—

Another factor that should be considered is the fact that each mill of a shorter mill train, with a low tonnage rate, is called upon to reduce the sucrose content more than a corresponding mill in a long train with a high tonnage rate, or, as Mr. ORTH aptly puts it, "There is more sugar in it to be taken out."

A feature of many mills in a train, that should be mentioned at this time, is the fact that the extraction of a 9-roller mill alone will be higher than the extraction of the same nine rollers in an 18-roller mill train. In 15 wet crushing tests at Ewa, where the 18-roller extraction averaged 98·18, the extraction back of the first nine rollers was only 93·10. This is lower than the two runs, conducted under test Number 3, and lower than the 94·13 extraction obtained with this same unit running for eight weeks in 1922 as a 9-roller mill. The explanation given to this phenomenon is that water is much more effective than return juice for macerating purposes.

CONCLUSIONS.

Although the tests reported do not tell us exactly what we are after, namely, the "relation of hydraulic pressure, maceration, and number of mills in a train, on extraction," there is much food for thought. Any one of the above three factors is all any one factory can hope to establish in any one season. It will require a great number of runs to get sufficient data where the dilution, grinding rate, and cane will average out to a mean figure giving a uniform curve.

A brief inspection of the sheet where various data have been plotted against milling loss will demonstrate the necessity of maintaining absolutely uniform conditions if anything like accurate information is to be obtained. If one is not certain that the quality of the cane remains the same, the test will be a failure; or if subsequent analysis shows the cane to have varied, comparison cannot be made. There is a general trend of increased dilution and slower grinding rate for the lower milling losses, but it is nothing more than a trend, and the points do not anywhere nearly approach a curved or straight line, but vary by wide margins above and below an ideal line or curve. The fact that per cent. polarization in cane, purity crushed juice and Brix crusher juice should have a declining tendency was a revelation.

Lastly, one cane may show the same sucrose and fibre contents as another and still be far from being alike. Badilla, for instance, here at Ewa, may show an average fibre content; still the fibres break up, giving us something like sawdust, which does not mill at all well and increases our milling losses out of all proportion.

Experiments carried out at the Washington State College, U.S.A.,[1] on the adverse effect on the following crop of ploughing in of straw, leaf, trash, sawdust, and the like, now indicate this may be overcome by the application of nitrate of soda as a supplement. "This discovery has considerable bearing on cane cultivation, and suggests that the ploughing in of sugar cane leaf trash, where practised should be followed by the suitable addition of some quick-acting nitrogenous fertilizer, if depressed yields are to be avoided."[2]

According to the Fahey Agreement, adopted in South Africa,[3] "cane not falling within the chemists' scale and report shall not be marketable cane, and may be rejected; it should not be paid for even if crushed," A planter in Zululand had about 1000 tons of cane rejected last season, and the general feeling appears to be that: "The fact can no longer be denied that a state of deadlock exists in respect to the Fahey Agreement[4] and steps ought to be taken at once to endeavour to overcome this deadlock, or at least arrive at a unanimous agreement in regard to it."

[1] *Soil Science*, 1927, 24, No. 2, 95. [2] *Tropical Agriculture*, 1927, 4, 198.
[3] *I.S.J.*, 1926, 633; 1927, 498. [4] *S.A. Sugar J.*, 1927, 583.

Dehydration of Sugar Beet.

Three publications on this subject have just appeared, the first a Report by Dr. B. J. OWEN[1]; and the second and third, papers[2] read before the Glasgow Section of the Society of Chemical Industry by Dr. C. SCOTT GARRETT, F.I.C., and Mr. G. W. RILEY, M.I.Chem.E., on the Desiccation (DE VECCHIS) Process and the drying plant used.

Dr. B. J. OWEN'S REPORT.

In his report Dr. OWEN now gives a very full account of the work done by him to date, this present account supplementing his two previous publications.[3] For example, he presents: Studies on the resistance of massed beet cossettes to air blast; considerations on natural heat reactions; studies of the effect of varying degrees of temperature applied for varying periods upon the chemical composition of sugar beet cossettes; mass drying; practical drying using circular chamber, belt conveyor mass drying, and mass tray drying. There would appear to be no doubt that means have been devised for drying beet that will not lead to inversion or to the formation of caramel. But no confirmation has been obtained of the de Vecchis hypothesis that a 2-stage drying process is necessary. On the contrary, the experimental work appears to show conclusively that the same effects of coagulating the albuminoids present can be obtained by a one-stage process. In practice, this result is obtained by drying in the mass, the effect of which is to give a uniformly dried product throughout, whilst controlling the chemical changes which occur through the application of heat.

The conclusion reached by DE VECCHIS, LEFEUILLE and others on the coagulation of the albuminoids by heat was confirmed, but no confirmation could be obtained of the hypothesis of these previous workers that cell-rupture occurs on drying beet. It follows that the process of extraction is one of normal diffusion, not of lixiviation. Nor is there any evidence that cell-rupture, if it occurrs, would be in any way an advantage. Juices obtained from dried cossettes are purer and much more highly concentrated than those produced from fresh beets.

Syrup clarification.—Syrup of 50° Brix and higher is obtained. It is true that, owing to the transformation of the nitrogenous organic matter during drying this syrup has a higher purity than the raw dilute juice obtained in the ordinary way, but owing to the concentration of the impurities that remain, and the viscosity of the product, clarification presents a special problem, upon the solution of which the value of the beet drying process mainly depends.

DE VECCHIS' method of clarification was tried, namely the addition of slaked lime to the amount of 2 per cent. of the weight of juice followed by a solution of superphosphate to an alkalinity of 0·07 per cent. CaO, calcium carbonate being added to the amount of 2 per cent. of the juice as filter-aid. But the juice filtered extremely badly under a very high pressure, and on opening the press a slimy sludge was found. This method of purification was concluded to be impracticable with juice of high concentration, as was confirmed by further trials. Following this, various modifications of the process were tried, but even with lime additions up to 6 per cent. the result was not good. A double filtration process, e.g., liming, filtering, treating with superphosphate, and again filtering gave the best results up to that stage, but none was deemed satisfactory for factory scale operation.

[1] "A Report on an Investigation into the Desiccation of Sugar Beet and the Extraction of Sugar." By B. J. OWEN, M.A., D.Sc., of the Institute of Agricultural Engineering, Oxford. Published by the Ministry of Agriculture (H.M. Stationery Office, London, 1927; price: 2s. 6d. nett.).
[2] *Chemistry and Industry*, 1927, 45, 1036-42; 1080-1084. [3] *I.S.J.*, 1926, 542; 1927, 145.

Centrifugal clarification was tried, the syrup being heated to 50° C., treated with 2 per cent. of lime and 1 per cent. of kieselguhr ("Supercel Hyflo") and passed through an "Alfa" Laval clarifier. This gave a considerably better result; the filtration rate was fairly satisfactory; and by this method (it is claimed) a good-class white sugar was obtained. A series of trials with "Suchar" was made, and good results obtained. Both methods of purification gave good results. The latter, though more expensive, gave a better yield of white sugar, as it was found that the green syrup obtained from the first strike of white sugar could be re-boiled to produce a second strike of white sugar. The syrup from the second strike produced a final molasses of low purity and a second-product sugar which was available for re-melting into the raw juice.

Dr. OWEN'S final conclusion is that "the investigation resulted in producing a new sequence of operations, and also new individual steps. The cost of the process has been examined,[1] and the results indicate *prima facie* that it has many economics worthy of the attention of the sugar industry. The total loss of sugar in the process is certainly not more, and is probably less, than in the diffusion process."[2]

DR. SCOTT GARRETT'S PAPER.

This paper gives a detailed account of the de Vecchis process, its advantages, and economics. Following are extracts taken here and there from it of points that appear of importance.

Dried cossettes.—Dried cossettes containing about 3 per cent. of moisture are stable, and can be preserved unaltered practically indefinitely. It is probable also that they will keep perfectly with a percentage of moisture up to 10 per cent. or 12 per cent., provided the albuminoids, etc., are "cornificated," i.e., have lost their hygroscopic power (owing to the coagulation of the albuminoids present), and the material is sterilized Dried cossettes are from 20 per cent. to 15 per cent. of the weight of the raw beet, and occupy from 120 to 140 cub. ft. per ton, or about half the volume of the wet material. Co-efficients of drying of from 3·8 to 5·8 have been obtained in large scale practice. They can be briquetted by the application of hydraulic pressure of from 250 to 300 atmos.; the compressed cake occupying about 37 cub. ft. per ton. So long as the conditions of drying laid down by DE VECCHIS are adhered to, analysis has shown that there is no loss of sugar, either through caramelization or degradation to invert sugar. On this point a large number of investigators previous to DE VECCHIS are unanimous and their results have not been questioned. At Sanguinetto, during last season (1927), tests were carried out on quantities of beet[3] in three periods, and showed the following results:—

BEFORE AND AFTER DRYING.

	Sucrose Before %	Sucrose After %	Invert Before %	Invert After %	Invert Ratio Before %	Invert Ratio After %
1st period (on 223·3 tons beet)	17·2	65·9	0·12	0·47	0·69	0·71
2nd „ („ 96·2 „)	16·2	64·8	0·27	1·10	1·66	1·69
3rd „ („ 687 „)	16·6	66·1	0·28	1·68	1·68	1.66
	16·9	66·0	0·21	0·24	1·24	1·27

This shows plainly that there is no practical difference in the invert ratio before and after drying. In these quantity tests, the average co-

[1] No figures are given. [2] Nor are any results cited here in support of this statement.
[3] Exceptional Italian crop due to the very dry season.

efficient of drying was 3·9 per cent., so that the efficiency of recovery of total sugar was 100 per cent. Thus we have: Original sugar $(16{\cdot}9 + 0{\cdot}21) \times 3{\cdot}9 = 66{\cdot}73$; recovered sugar $66{\cdot}0 + 0{\cdot}84 = 66{\cdot}84$.

Extraction.—Dried cossettes are extracted in the same manner as in the diffusion process. De Vecchis uses a battery of from 10 to 12 lixiviators (diffusers) of simple construction, the reheating type being probably the more satisfactory, since the quicker extraction increases the purity of the juice by about 0·3 per cent. to 0·4 per cent. It is estimated that a strength of approximately 60° Brix will ultimately be obtained in normal practice, a very great contrast to the dilute juice of about 15-17° Brix obtained by diffusion of freshly cut cossettes. This de Vecchis syrup differs essentially from ordinary diffusion juice both in the amount and in the different physical state of the impurities present. Colloidal gels, gummy and pectic states seem to be reduced greatly, leading to a lowered viscosity so that purification (defecation) and filtration, in spite of its great concentration, becomes a relatively simple matter compared with ordinary diffusion juice. De Vecchis does not make the claim of cell rupture, although he states that this is possibly the case to a slight extent. Experiments by Prof. Mezzadroli showed that whilst Italian diffusion pulp contained about 4·5 per cent., de Vecchis pulp from the same source contained 7 per cent. of dry matter, both reckoned on the wet pulp. The de Vecchis wet pulp averaged 80 per cent. and the diffusion pulp averaged 90 per cent. of the weight of the fresh beet, so that expressed on the original beet weight the dry matter in the pulp was, for de Vecchis pulp 5·6 per cent., diffusion pulp 4·05 per cent. The difference of 1·55 per cent. indicates nitrogenous matter which has not passed into the juice as impurities, and which enhances the quality and quantity of the exhausted pulp by-product. In the ordinary diffusion process the thin-juice obtained from the diffusion battery shows approximately the same purity as the original beet, the increase in purity between diffusion juice and pressed juice usually ranging from 0·2 per cent. to 0·5 per cent., but in the de Vecchis process there is an increase in the purity of from 2·5 per cent. to 3·5 per cent. The Eynsham experimenters have found the same phenomenon.

Waste waters.—Drain waters from the diffusers do not contain albuminoid matter, and therefore, if these waters are efficiently separated from traces of exhausted pulp, they can be passed to the drain without fear of subsequent decomposition or putrefaction taking place owing to the action of bacteria on the nitrogenous matter. In view of the outcry in England against the pollution of streams, this is very important. In Italy the Ministry of Health exempt all De Vecchis factories from any treatment of their waste waters. Strong nitric acid, trichloracetic acid, alcohol or ether ring tests can be used to establish the absence of albuminoid matter in waste liquors or lixiviation juice.

Defecation.—Defecation of the syrup is a simple process indeed compared to the multiple carbonatation and sulphitation processes required to purify ordinary diffusion juice. All that is necessary is the addition of 0·25 per cent., calculated on the weight of fresh beets for purities superior to 80 per cent., and for inferior purities about 0·30 per cent. of lime as milk-of-lime. Filtration is easy in consequence of the absence of viscosity and freedom from albuminoid, pectic and gummy substances. Hard granular cakes are obtained which are readily washable, a system of washing being used whereby the wash liquor going forward into the juice is of sufficient strength that there is no appreciable lowering of the strength of the defecated juice.

There is less loss of sugar in the de Vecchis cakes than in diffusion cakes. The increase of purity for de Vecchis defecation is not so great as that obtained by the ordinary process, because there has already been a purification of 2·5 to 3·5 per cent. But the total purification, in extraction and simple defecation together, quite equal that produced in the diffusion process by carbonatation, etc. After passing through a Danek safety filter, the liquor is ready for crystallization. In all, lixiviation and defecation together produce from about 5 per cent. to 6 per cent. or more increase. This epuration of 5-6 per cent. is only possible with low-grade beets. In countries where the beet has an original press-juice purity of 86-87 per cent. a lower percentage epuration overall will be experienced by both processes.

Crystallization.—In the purified juice, after passing the safety filters, is dissolved all the second-product sugar, which brings its strength to 60° Brix or over. It is now pumped directly to the vacuum pans and concentrated to crystallizing point. The massecuite is discharged to the crystallizers and then centrifuged, giving the first-product raw sugar. With beets of original purity about 83 per cent. and defecated juice of 88 per cent. to 89 per cent. purity, massecuite purity will be 92 per cent. or higher. From beets of 74 per cent. to 76 per cent. purity, 6 per cent. molasses on the weight of raw beet was obtained at Lorea, whilst a diffusion process factory gave 6·5 per cent. molasses on the same raw beet supply. Samples of molasses in last season's work at Sanguinetto showed (on 250 tons): Brix, 80·6°, sucrose 46 per cent., purity 59·7 per cent., ash 5·7 per cent. White sugars polarizing 99·9° can be made.

Advantages of the process.—By drying the cossettes and rendering them stable and storable, the extraction can be carried out at any time or continuously throughout the year. With continuous working for the same production of sugar, therefore, a de Vecchis plant need only be of one-third the capacity of a similar plant using the ordinary system. As, however, the beets are dried only during the beet harvest, the de Vecchis process requires the same size of washing and slicing plant as the ordinary process, and, in addition, the drying plant and storage accommodation for two-thirds of the beet supply in the shape of dried cossettes. Points in favour of the continuous production of sugar are regulation of supplies according to the demands of the sugar market, and continuous employment at the factory for the operators. De Vecchis factories, by reason of their more economical production, can be of smaller total capacity, factories of 20,000 to 25,000 tons per annum being possible, as they are in Italy. A washing and slicing plant, coupled with a drying unit, could be installed in an outlaying acreage, and the dried cossettes transported to a factory, saving thereby (owing to the decreased weight) about four-fifths of the freightage. Other advantages are the increased amount and quality of the exhausted pulp due to its albuminoid content, the fertilizing value of the press-cakes due to the contained phosphates, and especially the non-putrescible nature of the effluent which makes its treatment a relatively simple and inexpensive matter.

Economics.—Italian conditions differ from English on account of the cheapness of their labour, their cheap supplies of electric power, and their extraordinarily low building costs. A comparison, however, is valid, and whilst exact figures of cost of production cannot be given, the difference can be indicated. In the subsequent remarks the English equivalent is based on the rate of exchange existing at the time. In 1925-26 the national price for beet was 107 lira, or 17s. 10d. per ton. During last season the de Vecchis

Lorea factory paid 125·4 lira or 20s. 10d. per ton. As the working showed that the yield, which was normal for the Italian beet used, of marketable sugar was one ton per 10·8 tons of beet, this amounted to 32s. 5d. extra per ton of sugar produced. Under English conditions, after the experience gained at Eynsham, the Ministry of Agriculture has drawn up estimates of working cost under different scales of operation. Thus, a 100,000-ton factory, £4 7s. 6d.; and a 25,000-ton factory, £5 8s. 2d. per ton of sugar on a 13·25 per cent. extraction, exclusive of the cost of the fresh beet and depreciation, but inclusive of all other overhead standing charges. The capital cost of De Vecchis installations in this country, compiled from the estimates of responsible manufacturers and contractors, can be given as follows :—

	25,000 Tons. £	50,000 Tons £	100,000 Tons £
Plant and erection	46,200	73,700	115,500
Dryers and erection	15,000	25,000	50,000
Buildings and erections, including roads, rails, soils, flumes, etc.	36,720	59,220	99,300
Total	97,920	157,920	264,800

Allowing, therefore, depreciation at 10 per cent. increases the cost of production for a 25,000-ton plant to £8 6s. 11d., and for a 100,000-ton scale to £6 7s. 3d. per ton sugar. It is difficult to obtain really reliable figures of costs from the English diffusion factories, and figures have been given of from £10 to £15 per ton. A successful and well-run English factory, where the cost represents a minimum, gives a figure for a 100,000-ton factory of £6 per ton, excluding depreciation. The published cost of erecting such a factory is not far off £400,000, and on the same yield of sugar, depreciation at 10 per cent. would add another £3 to the cost.

Compared with the de Vecchis process on the same scale, this amounts to an increased cost of 52s. 9d. per ton of sugar, or, with the smallest scale factory, 13s. per ton of sugar. If the cost of production under the two systems were the same, there would still be a considerable advantage to the new process, owing to this decreased capital expenditure for the same output of sugar. In Italy the difference in capital outlay on factories under the two systems has been placed at about 3 or 4 : 1, but we see from the figures already given that in England the ratio is about 40 : 26·5. The reasons for this reduction of capital expenditure lie in the simplified extraction plant in continuous working, which reduces the size of the extraction and refining plant to roughly one-third of that of a diffusion plant of the same capacity, in the elimination of lime-kilns, carbonatation plant, sulphitation plant, and multiple-effect evaporators. The washing, slicing and reception equipment will be the same for both plants, whilst the de Vecchis plant requires dryers and a cossette store as items which are not represented in diffusion plants.

De Vecchis has drawn up a useful comparison for 100,000-ton plants operating in England, which is tabulated below. With a production of 13,000 tons of sugar, the difference amounts to 54s. 2d. per ton of sugar. One item, fuel, is increased, due to the desiccation operation, which requires approximately 600,000 calories (kilogram calories), 2,400,000 B.Th.U. per ton of beet. As the air is heated to a very moderate temperature, a fuel of low calorific power and small cost can be employed; in this particular case, residual smalls of gas-oven coke, which—while it has a calorific value of 5500 to 6000 C. units (10,000-11,000 B.Th.U.)—generally

costs less than half the price of high calorific value fuel normally used in sugar factories, the prices being : Small coke, 12s. to 13s. ; ordinary factory coals, 26s. to 30s. per ton, delivered at the factory. This reduces the fuel cost for drying to about 5 to 5½ per cent., and since, for all the remainder of the work, the fuel consumption is restricted to another 4½ per cent. to 5

	Diffusion Process. £		De Vecchis Process. £
Beets at 54s. per ton	270,000	..	270,000
Fuel	10,600	..	12,900
Wages and salaries	28,250	..	22,200
Rates, fares and insurances	8,000	..	5,000
Office expenses	2,000	..	1,300
Consumable stores, bags, limestone, or lime and superphosphate	25,500	..	15,100
Sundries	3,000	..	1,150
Brokerage	5,000	..	5,000
Bonus to growers	12,000	..	12,000
Excise tax	89,000	..	89,000
Incidental	7,000	..	5,000
Depreciation (10 per cent.)	40,000	..	26,500
	£500,350		£465,150
Difference			£35,200

per cent. as a maximum, it may be concluded that the greater consumption of coal by the de Vecchis process amounts to the difference between the total of these, 9½ per cent. to 10½ per cent., and about 8 per cent. or 8½ per cent., which is consumed in the best-equipped and most scientifically-run factories of the normal type producing refined white sugar. On the other hand, many diffusion factories have fuel consumptions of 10 per cent. and over.

The de Vecchis process should not be considered as a possible rival to the diffusion process, but rather as a process which, grafted on to the older process, could double or treble the annual output of these factories. The advantage to the factory is a doubling of output for only 25 per cent. increase of capital.

Beet sugar manufacture and the subsidy.—The subsidy declines in two three-year old periods from £19 10s. to £13 and £6 10s. per ton of sugar. The present campaign is the last of the £19 10s. subsidy, and no provision is made for the 1934-35 season. If we take one of the oldest, largest, and most successful factories as an example, we may arrive at some conclusion as to whether or not the industry will survive the subsidy. On last year's working the trading profit, not including overhead charges for depreciation, was £307,000, whilst the subsidy was £505,000. About one-third of the subsidy is returnable as excise duty, so that the net subsidation was £337,000. Without the subsidy there would have been a trading loss of about £30,000, which amounts to 3s. 9d. per ton on the 160,000 tons of beets worked. Putting depreciation at £45,000, overheads, including income-tax at £60,000, and dividend at £90,000, gives another 24s. 3d. per ton of beet, making in all 28s. per ton. To maintain the present position, therefore, when the subsidy is removed, the cost of beet must drop by 28s. per ton to 30s. per ton, since the grower at present receives about 58s. per ton. The average of yield is about 8·5 tons of beet per acre, giving at the present price about £24 10s. of which about £18 10s. is swallowed up in costs, whilst at 30s. per ton the return would be £12 15s. Even if by good cultivation and other improve-

ments the yield can be made equal to the high German yield of 10½ tons, when the return becomes £15 7s. at a selling price of 30s. per ton, there will be no profit to the farmer.

Although isolated cases occur in which the sugar content of the beet reaches 21 per cent., the average is about 17 per cent., which compares favourably with that of the best beet grown abroad. At present every per cent. over 15½ means an addition of about 2s.6d. per ton to the basic price of 54s. Given the 10½ tons per acre yield, the farmer would have to increase the percentage in his beet by over 2½ per cent., keeping the present rate of increase in price with increase in sugar content, to balance his expenditure if the costs of production remained the same, and to make a profit one would have to do considerably better. This does not seem possible with labour conditions as they are at present. Since every percent. of content up to 15½ per cent. costs 3s.6d., and any percent. over this costs only 2s. 6d., the factory under the present system gets cheaper sugar in the higher percent. beet and to this extent it would benefit. Even if the factory reduced both its dividend and its overhead by 50 per cent., which would bring the price up to 38s. 4d. per ton, or £15 5s. 10d. per acre on the present yield of 8·5 tons, or £19 12s. 11d. on the average of 10½ tons, still it would not be a paying proposition to the farmer unless he either reduced costs or obtained a higher percentage of sugar than 17 per cent. We have assumed here that with the extinction of the subsidy the excise duty is also extinguished, but if this is not so, then for the example taken an additional £168,000 would have to be found or a reduction of beet price by 21s. per ton, leaving a price of only 17s. 4d. per ton.

At present a 100,000 factory costing £400,000 pays about 58s. per ton for beet of 17 per cent. sugar content. With a total extraction of 94 per cent., a high extraction efficiency, 13⅔ tons of sugar and about 4⅗ tons of molasses are obtained from 100 tons of beet. Subsidy of about £286 10s., or 57s. 4d. per ton of beet, will be received on this production, making the actual payment by the factory for the beets about 1s. per ton. With the extinction of subsidy, how will it face the position ? If during the subsidy period reserves have been built up and plant value annually depreciated, say, at 10 per cent., then at the end of the subsidy period the capital value of the factory will have been practically wiped out, and an annual sum of, say, £40,000, or 8s. per ton, will in future be available for purchasing beet. Cutting a dividend charge of 10 per cent. and taxes and overheads to the same amount would supply another 16s., whilst another 3s. per ton of beet might be obtained if manufacturing costs were reduced by about £1 per ton of sugar (a very unlikely contingency). Altogether we have 27s. per ton of beet, so that nominally the factory can now afford to pay 28s. per ton of beet. This is just above the price of 25s. to 27s. paid for beet in unsubsidized and unprotected foreign industry, which can place raw or finished sugar on our market. At this price, however, it would seem that the farmer could not possibly produce beet, even with increases both in yield per acre and sugar content. For this period of reduced subsidy, commencing next season, the National Farmers' Union, in agreement with the manufacturers, has recommended to its branches a price of 46s. per ton for beet of 15½ per cent., with an addition of 3s. for the first per cent. over and 3s. 4d. for any additional per cent. This represents a price of 50s. 8d. for 17 per cent. beet, as against the old price of 57s. 9d., or 7s. reduction for 17 per cent. beet and 8s. for 15½ per cent. beet. The subsidy reduction of £6 10s. per ton sugar is equivalent at the yield we have taken (80·3 per cent., 17 per cent. beet) to 17s. 9d. per ton

beet, so that the proposed new scale on the average divides the reduction between the farmer and factory in the ratio 42·33 per cent. to 57·66 per cent. If this rate of reduction is accepted, and can be applied to the two subsequent periods, then the farmer may expect ultimately 30s. for 15½ per cent. beet and 36s. 9d. for 17 per cent. beet. The factory, on the other hand, will have to reduce their overall cost of 1 ton of sugar by about £11 to £12.

The above analysis would seem to show that the cost of manufacture is in this country about £1 to £2 per ton above foreign costs, and the natural question is, can this be reduced? Reduction in manufacturing costs can only be effected by improving the efficiency of the operatives or of the plant. We think, therefore, that the de Vecchis process provides an alternative way out of the impasse, and may well close this gap, as it appears possible for this process to contribute about 8s. per ton from both lower manufacturing cost and the increased dividends which it opens up. This contribution of 16s. per ton to the price of beet, with the other savings, should enable the industry to stand on its own feet.

Mr. Riley's Paper.

In the third and last paper a description is given of the design and operation of a British beet band-dryer. One of the earlier designs of dryers used at Lorea, Italy,[1] had given rise to considerable difficulty in operation, as did some other types used in Italian factories. Designs were accordingly prepared for a fire-heated band-dryer to deal with 70 tons of washed and sliced beet per 24 hours, working with the limiting temperatures specified by Dr. de Vecchis and providing the coagulating conditions desired. This was erected and put to work at Sanguinetto, Italy, for the 1926 campaign. The machine was provided with three endless drying bands in the top chamber and two endless bands in the bottom or coagulating chamber, and was heated by means of five hand-fired furnaces working under balanced draught, burning small coke and *Rubbli Kulm* likely to provide the most satisfactory commercial results in view of the comparatively low cost of Italian labour. Provision was made for 15 different periods of drying, the total times for drying and coagulating varying from 2 to 3¾ hours. Regarding fuel consumption, this was from 4·9 tons of fuel oil to six tons per 100 of washed beet, the oil having a heating value of 10,500 calories (18,900 B.T.U.), corresponding to 6·86 to 8·4 tons of 7500 calories (13,500 B.T.U.) fuel per 100 tons.

The machine worked continuously from early September until December 21st, 1926, and the Company at Sanguinetto were so satisfied that they decided to put down for the 1927 campaign a larger 100-ton machine to work alongside the first. It is practically a duplicate of the earlier, except in several minor details which embody the results of experience with the earlier machine, the method of feeding the wet cossettes, the provision of a further drying band in the top drying chamber, and the use of oil fuel in the furnaces. Both machines are at work producing very satisfactory cossettes from a crop which, for Italy, is exceptionally high in sugar content. The fuel consumptions are extremely low, and there is no trouble from unconsumed fuel oil being carried forward to the cossettes from the burners.

Among new companies recently formed in the U.K. are the following: Sugar Trust, Ltd., 66, Coleman Street, E.C. 2 (225,049). Public. To build factories and works, etc. Nominal capital, £12,000 in 1s. shares.

[1] White Paper, Cmd., 2343 (1925).

Publications Received.

Sugar Manual. (Cifra Ltd., 87, Bishopsgate, London, E.C. 2.) 2s. 6d.

This is a useful 100-page manual, published by an issuing house in London, and is the first one that has come to our notice that gives under one cover a list —drawn up on the lines of the Stock Exchange Yearbook—of all the sugar companies registered in the United Kingdom, as well as a few of the leading American and Canadian ones. Some 30 preliminary pages are devoted to data on the sugar industry (Consumption, Production, Beet Sugar, Beet Sugar Factories, the Beet Subsidy, Sugar Prices, etc.) which bear evidence of careful preparation and are based on information supplied by competent authorities. We note with interest that an attempt is made to estimate—and that favourably—the prospects of the home beet industry when the subsidy entirely ceases. Assuming a factory dealing with 80,000 tons of roots, and taking sugar at 30s. per cwt., the balance of profit at the end of a campaign is put at rather over £50,000. But it is assumed also that the farmer will be then able to grow and sell beet profitably at 37s. 6d. per ton. This manual is of course mainly intended as a means to attract investors to the sugar industry, but it is well worth the study of all those who wish to get some idea of the financial side of the beet sugar production at home, and to a smaller extent of cane sugar manufacture abroad.

Desiccation of Sugar Beet and the Extraction of Sugar : With a Note on the Treatment of Sugar Beet Effluents. B. J. Owen, Institute of Agricultural Engineering, University of Oxford. (H.M. Stationery Office, London.) 1927. Price : 2s. 8d., including postage.

Dr. Owen has now submitted to the Ministry of Agriculture his full report on his investigations into the desiccation (De Vecchis) process, accounts of some of his results having already been given.[1] A considerable amount of experimental matter is here presented, and a summary of the most important of it is given elsewhere. An account is given also of experiments on the screening and filtering of beet factory effluents, using a Brackett, two-stage, cup-type screen, and a Pennell-Wyllie filter. This appendix will also be dealt with later.

Tabelle zür Berechnung der Schmutzprozente. (Tables for the Calculation of the Dirt Tare.) W. Hirschfeld. (Rudolf Rathke, Publisher, Magdeburg.) 1927. Price : RM. 15.

These tables give the gross, tare, and nett figures from 2 to 65 per cent. for 500 to 5500 kg. with intervals of 10, and from 5500 to 50,000 kg. with intervals of 5000, thus enabling any computation of the dirt tart to be made rapidly and accurately. The printing is clear, the paper good, and the linen binding strong, and suitable for much handling.

Honderd Jaar Machine-Industrie op Oostenbrug, Amsterdam. Dr. M. G. de Boor. (Druk de Bussy, Amsterdam, Holland.) 1927.

This volume has been published to commemorate the centenary of the foundation of the well-known Werkspoor firm of Amsterdam. It is an historical publication of great interest, illustrating well in text and in picture the considerable part played by Werkspoor in the development of several branches of engineering, not least in that concerned in the supply of sugar machinery.

Van Nostrand's Chemical Annual. Edited by John C. Olsen, Ph.D., D.Sc. Sixth issue. (Chapman & Hall, Ltd., London.) 1927. Price : 21s. net.

Van Nostrand's Chemical Annual, now in its sixth edition, is a laboratory reference book of data, largely numerical, much used in the U.S.A. It covers a very wide range, and presents a very great mass of information in an orderly form, dealing with every branch of pure and applied chemistry. Among the additions to this new issue are tables on H.I.C. values, isotopes, specific gravity and solubility. It is a very valuable *vade mecum* for the chemist.

[1] *I.S.J.*, 1926, 542 ; 1927, 145.

Brevities.

The British Association of Chemists, which is a body existing in the U.K. to promote the status and interests of technical and analytical chemists, has just issued the first number of their new publication *The Chemical Practitioner*, which makes an eloquent plea for co-operation on the part of various organizations regarding the needs and activities of the chemical profession.

Sugar bags made from the fibre of *Malva cubana* are said to be found much more economical than those imported from India, the price of which is 35-38 cents each.[1] This textile was grown at the Experiment Station of Santiago de las Vegas, Cuba, and the satisfactory results there obtained in the cultivation and weaving of the new fibre have led to the manufacture of these bags in that country.

A company with a provisional capital of one million yen has been formed in Tokio for the purpose of paper production from bagasse according to the patented process of Umeshiro Suzuki. In Formosa it is estimated there is available enough bagasse to produce the same amount of paper as is at present furnished by 600 million cub. ft. of wood. A plant has been installed at the Giran Sugar Mill, Formosa.

To differentiate vegetable from animal charcoal, it is recommended that the charcoal, starch and rosin, in the proportion of 2 : 1 : 1, are mixed, a finger print taken, the fine mixture dusted over with a soft brush, the superfluous powder removed, and the glass heated for a few seconds over a non-blackening flame. A black fixed inprint, like an etching, is obtained with vegetable charcoals, but no fixation occurs with animal charcoals.

The Fulton Iron Works Company has acquired a substantial interest in the Foos Engine Company, a firm who build Diesel engines; and the two companies, though each retaining its identity, will work in co-operation. Small Diesel engines will be manufactured by the Foos plant at Springfield, Ohio, and large ones (up to 2000 h.p.) by the Fulton Co.'s plant at St. Louis. The Fulton Sales Organization will attend to the sales of all ranges of Diesel plant.

Certain changes in the personnel of the Darco Sales Corporation are announced. Mr. A. A. Jackson, who has been associated with the firm since its organization in 1922, has resigned his post as Vice-President. Mr. Herbert G. Sidebottom, who has had a wide experience in the chemical industry and was for many years secretary of the New York section of the American Chemical Society, has been appointed assistant to the President, Mr. George C. Lewis.

Tests conducted at Iowa State College on jelly-making using cane and beet sugars under identical conditions have led to the conclusions that failures are not due to the kind of sugar used, but to one or more of the following conditions: To the juice containing too little pectin, too little acid, or too much water; to the jelly being boiled too long; or, again, to the addition of too little or too much sugar for the amount of pectin in the juice, a very firm hard jelly being produced in the former case, and a thin, sticky, syrupy jelly in the latter.

An exhaustive series of experiments carried out by E. Haselhoff and W. Elbert[2] on the effect on subsequent growth and yield of treating the seeds of many plants with solutions of manganese and magnesium salts, and of certain proprietary preparations, leads to the conclusion that no case can be made out for any general stimulating action of such solutions on plant growth. Popoff's results, for example, could not be confirmed.

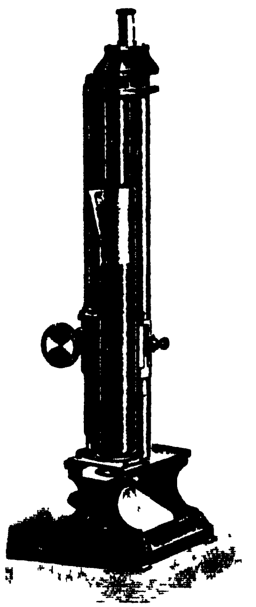
Dr. Ph. van Harreveld reminds agriculturists that *cachaza* or filter-press mud has only a very limited value as a fertilizer. In 33 samples, with an average water content of 29 per cent., the average content of nitrogen was 0·8 per cent., so that large quantities are required to give sufficient quantity of nitrogen. This nitrogen is present in slowly available form. Its phosphate content, moreover, ordinarily is very low, furnace ashes having a much higher value in this respect. During 1926 only seven centrals in Java out of 177 used filter-press mud for manuring.

[1] *Bulletin of the Pan-American Union.* [2] *Landw. Versuchs-Stat.*, 1927, 106, 285-322.
[3] *The Planter*, 1927, 79, No. 19, 365-366.

Review of Current Technical Literature.[1]

COLORIMETRY, AND THE IMPROVEMENT OF THE STAMMER COLORIMETER. **K. Zert.** *Zeitsch. Zuckerind. Czecho-Slov.*, 1927, **57**, *No.* 6, 57-63.

An exact determination of colour in sugar factory products is of importance in white sugar factories; and, besides the Lovibond, Josse, Oswald, Goerz, Hess-Ives and Hoffmann instruments, the Stammer is largely used. This last-mentioned colorimeter is, however, subject to a number of sources of error among which may be mentioned the following: the zero-point sometimes cannot be adjusted, it being impossible to bring the two halves of the field of vision to the same colour[2]; normal and half-normal glasses are sometimes confused on account of their similarity; prisms and ocular lenses may require cleaning; and the light used may be unsuitable, since the yellower this is, the more inexact will be the readings, diffused day-light, or a true day-light lamp being the best to use. A further and more important source of error is the composition of the colour of the glasses, which is made up of a mixture of red, green and yellow, or rather greyish-yellow, in order to match the colour of sugar products. But the proportion of these primary colours is not always the same in the different products encountered in the factory and refinery, those composing clarified juice and evaporator syrup, for example, being different from those making up molasses and after-products (e.g., re-melts), which latter two always contain more red. Not only this, but the colour-glasses are not constant. An examination of the colour components of ¼, ½ and normal glasses of various colorimeters has been made by the author at the Prague Sugar Experiment Station using the Hess-Ives instrument for so doing, and even in the case of new glasses of the same maker these were found sometimes to vary, so that not only their tint, but also their intensity was variable. It was possible with some of these glasses to match normal, clarified (beet) juices, but with others of them, e.g., those containing a lower proportion of red, an exact compensation of the two halves was not possible. It is suggested in such circumstances that compensation should be effected by the use of a red-glass wedge, which may be inserted either on the glass or the solution side, as the case demands, in order to add red where this is necessary so as to obtain a more equal match. Normal clarified juices require a glass containing 80 of yellow, 27 of red, and 8 of green (expressed in Hess-Ives units), while molasses should have one in the proportion of 80 : 42 : 16, this latter colour thus being much redder and greyer. In the case of cloudy solutions (which cannot be cleared by filtering) the two halves of the field will not match in the ordinary way, this being owing to the fact that, due to the fine suspensions, less light is transmitted. A device for obtaining a more exact reading consists in slightly screening the opening admitting light to the glasses, so as to diminish the amount admitted, while at the same time adjusting the height of the juice-column, until an equal greyish-yellowttion is obtained in the two halves. Coming now to cases in which the tint of the solution differs distinctly from that of the colour-glasses, so that the sides of the double-field are unequal, the author here advises that monochromatic light should be used to match each of the components, a bluish-violet filter being used for the yellow, a green for the red, and a red one for the green. In this way the colours composing all factory products can be measured, and thus the moderate-priced Stammer instrument adapted to give the same colour analyses as the more costly colorimeters.


Stammer Colorimeter.

[1] This Review is copyright, and no part of it may be reproduced without permission.—Editor, *I.S.J.*

[2] This, of course, is not so in instruments of the best construction.

ERROR IN POLARIZATION PRODUCED BY EVAPORATION. **C. Rudolph Kargl.** *Zeitsch. Zuckerind. Czecho-Zuckerind.*, 1927, **51**, *No.* 43, 519-523.

One of the errors occurring in the determination of the polarization of sugar products, e.g., raw sugars, is that arising from the concentration of the solution during filtration as the result of evaporation. BATES and PHELPS[1] have shown that when the funnel is uncovered and when part of the solution is returned for re-filtering, the increase in polarization may amount to several tenths of a degree; but that, on the other hand, when the funnel is covered with a clock-glass, practically no increase results. In Czecho-Slovakian sugar factory laboratories this precaution is not generally observed, a filtering arrangement, as prescribed by

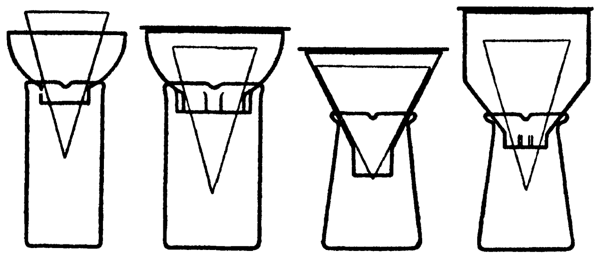


FIG 1. FIG. 2. FIG. 3. FIG. 4.

MATEGCZEK (Fig. 1) being often used, the long cone of filter-paper protruding from the "funnel" not permitting covering. WEISS, however, has modified this arrangement for rapid filtration, the cone of the paper resting on a ring, well inside the "funnel," which is closed by a plate as shown (Fig. 2). VONDRAK recommends the stem-less funnel arrangement,[2] which in modified form is in use in the Prague Sugar Experiment Station (Fig. 3). In order further to investigate this matter, the writer ascertained the loss of weight directly, namely by weighing the whole filtering apparatus on a balance with a sensitivity of 0·02 grms., 100 c.c. of normal weight solution of raw beet sugar, clarified with 1·5 c.c. of basic lead acetate solution being filtered, the time allowed being 10 mins. Using the apparatus depicted in Fig. 1, the water evaporated during the time stated was 0·05 grm., this being equivalent to an increase of polarization of about 0·05° V. In the funnel apparatus shown in Fig. 3, which was covered, the loss was only about 0·004 grm., the change in the polarization therefore being practically nothing. This was under ordinary laboratory conditions of low temperature and average atmospheric moisture. In extreme cases Fig. 1 apparatus was capable of giving rise to a loss of 0·2 grm. in the weight, i.e., a rise of polarization of about 0·2° V., or 50 times greater than in the closed funnel arrangement. But while the ordinary stem-less funnel device obviates practically the error in question, it filters slowly, taking in fact about twice as long to pass say 60 c.c. as the so-called "ring" apparatus shown in Figs. 1 and 3, due, no doubt, to the fact that in the first the whole of the area lies against the side of the funnel, whereas in the second arrangement only a small part of the surface is so impeded. Consequently the author has again modified the Mategczek arrangement to the arrangement in Fig. 4, the neck of the funnel being provided with a couple of openings so that none of the filtrate collects there. Using this device the loss of weight during filtration is only 0·003 when covered and 0·102 grm. when uncovered, this being at 19° C. (66°F.) and 50 per cent. hygroscopicity.

H.I.C.: COMPARISON OF COLORIMETRIC AND POTENTIOMETRIC RESULTS IN CANE FACTORIES. **H. A. Cook.** *Reports of the Association of Hawaiian Sugar Technologists*, 1927, 110-115.

In nearly all the factories of the T.H., the spot-plate method, using a colour-chart adopted by the Experiment Station, is in use, and a careful comparison representing over one thousand determinations has been kept between the results thus

[1] *I.S.J.*, 1914, 265. [2] *Deut. Zuckerind.*, 1910, 1005.

obtained, and those found by the potentiometric procedure, recognised to be the more accurate. On the whole the results given by the colorimetric method agree within 0·2 *pH* of those found potentiometrically, which is accurate for all practical purposes. A few wide variations are, however, shown, the greatest being 0·6 *pH* using brom thymol blue on undiluted juice, but such differences will not occur if (as specified by the Experiment Station) the juice be tested at a 1 : 3 dilution. Another difference was about 0·4 *pH* with brom thymol blue in the upper part of its colour range, which appears unavoidable with this indicator, as comparisons at this part of the scale are difficult, owing to the slight variations in colour, and due also to the influence of the colour of the solution. Yet another difference observed, not a considerable one, was 0·26 *pH* on the low spot of the phenol red scale. But the average values of all the colours over the effective ranges gave differences considerably under 0·2 *pH*, which can be regarded as very satisfactory for present purposes. In using brom thymol blue, it is true that the colouring matter of the juice exercises some effect, but accurate results can be obtained up to 7·2 *pH*, while, as regards spots above this, they can be determined by both phenol red and cresol red. These two indicators give results about as accurate on the undiluted as on the diluted juice, though the colours are clearer and more easily placed in the latter case. In using thymol blue, dilution has little effect up to *pH* 8·6, and between 8·6 and 9·0 the results are a little more accurate when the liquid is diluted. Some of the main factors which tend to influence the reliability of the results are in addition to colour and dilution : salt content, lighting, reaction of the indicator solution, skill in judgment of colours, care and skill in manipulation. If the effect of colour and turbidity could be compensated, still more accurate results would undoubtedly be secured. Dilution changes the concentration of the solution, and therefore the concentration of the salts and hydrogen ions, and thereby the degree of dissociation of the complex salts and other substances present in the solution. Fortunately, most of our juices are sufficiently buffered to offset the effect of dilution to such an extent that practically accurate results are secured. In as much as the results are usually more accurate, a dilution of one part of juice with three parts of distilled water is still recommended. Undoubtedly there is to be expected some salt effect on the indicator, depending upon the salt content of different juices. Lighting is an important factor. The best is good, clear daylight, not direct sunlight, preferably from a north source. If a night shift is operated so that artificial light is required, the day work should also be done by the same lighting system, a blue daylight globe giving good results. It must be remembered that the reaction of the indicator solution will influence the results. Technique, cleanliness and care should always be exercised and contamination from any source should be avoided. The colorimetric method is simple, and if the instructions are observed, accurate results should be obtained.

COMPONENTS OF CANE JUICE : THEIR BEHAVIOUR IN THE PROCESS OF SUGAR MANUFACTURE. **F. Hardy.** *Tropical Agriculture* (Sugar Supplement), 1927, **4,** No. 9, 38-40.

Assuming average figures, the components of cane juice other than sugars occur in the following entities and amounts : carbohydrates other than sugars, comprising hemicelluloses and pentosans (chiefly xylan) 8·5, and pectins, 1·5 ; organic nitrogen compounds, consisting of higher proteins (mainly of the albumin type) 7·0, simple proteins (as albumoses and peptones) 2·0, amino-acids (as glycin and aspartic acid) 9·5, and acid-amides, (chiefly asparagin) 15·5 ; organic acids, other than above, including vegetable acids and carbohydrate acids (e.g., aconitic, oxalic, succinic, glycollic and malic acids) 13·0 per cent. ; colouring matters (including chlorophyll, anthocyans, saccharetin, and tannins) 17 per cent. ; waxes, fats and soaps 17 per cent. ; inorganic salts (including phosphates, chlorides, sulphates, silicates and nitrates of sodium, potassium, calcium, magnesium, aluminium and iron) 7 per cent. ; and silica, free or in organic combination, 2·0 per cent. In this summary it is to be noted that more than one-third of the total solids-not-sugar are organic compounds of the protein type ; that waxes, fats and soaps occur in expectedly large proportion, and that the " gums and pectins " occur in relatively low amounts,

though they cause perhaps the most trouble in regard to elimination in the process of clarification. Of the non-sugars mentioned above, the hemicelluloses, pentosans and pectins, the higher proteins, the waxes, fats and soaps and the free silica are in colloidal solution, and possibly some of the others as well. Regarding the detrimental effect of heat, sucrose is inverted at *pH* 4·6-5·8 ; and furthermore, prolonged heating of sucrose in solution leads to caramelization with concomitant undesirable darkening in colour. The oxidation of hexose sugars into various volatile, or dark-coloured, or acidic substances, is also doubtless enhanced by heating, although other factors, such as alkalinity and the presence of phosphates and iron, are probably of greater moment.[1] Heating also accelerates the hydrolysis of hemicelluloses and of the true-cellulosic components of bagacillo. This generates further quantities of gummy pentosans, and is therefore highly detrimental. On the other hand, heating produces some beneficial effects, colloidal substances such as hemicelluloses, pentosans, pectins, proteins and silica, are prone to dehydration, which may cause their precipitation (in the case of albumin), or facilitate their subsequent elimination by lime (in the case of silica and perhaps of pectins). It may at least render them somewhat more susceptible of removal by physical agents which act through surface combination (" adsorption "). In the case of organo-silica compounds, believed by some to occur in sugar cane juice, heating may effect fission, so that the silica fraction is separated in a more or less hydrated state. Continued hydrolysis may effect some disruption of pentosans and pectins into pentose sugar and other simple non-colloidal residues, though little is yet known of the possible significance of this action, which may have far-reaching importance. Addition of lime firstly reduces acidity, and may impart alkalinity, and secondly, adds calcium to the juice. Neutralization of acidity prevents loss of sucrose through hydrolysis, but alkalinity encourages the oxidation of hexose sugars, and increases the formation of dark-coloured " humic" substances resulting from this change, and from a similar change that may also affect the carbohydrate non-sugars, such as pentosans. Addition of calcium produces profound results, it combines with proteins to form insoluble coagula which settle ; it forms insoluble compounds with some of the organic acids, and with many of the inorganic salts, notably phosphates ; it may yield a certain amount of insoluble calcium pectinate ; it produces insoluble calcium soaps from the fats and waxes, and it combines with and precipitates free silica and clay. Furthermore, some of these various lime-precipitates are said to carry down with them significant amounts of the less amenable impurities, such as pectins, pentosans, proteins, and colouring matters. Belief in this last mentioned fact has partly led to the deliberate addition of phosphoric acid or of soluble phosphates to cane juices deficient in phosphate, in order to improve their defecation by liming, and to the practices of sulphitation and of carbonation in white-sugar manufacture. Fats, waxes and soaps may give great trouble both because of the difficulty in effecting their precipitation, and because of their greasy nature, which renders limed cane juice filtration slow and tedious. Liming only partly precipitates them, and cloudiness in limed and settled juices is frequently attributed to their presence. Furthermore, the calcium salts (" soaps ") derived from them are a common cause of evaporator scale. Pentosans and pectins escape complete precipitation by heat and lime, although they may be partly eliminated by adsorbents, such as diatomaceous earth, various chars, and surface-reactive precipitates, such as calcium phosphate, calcium sulphite and calcium carbonate that are generated in limed juices by various procedures. Ordinarily, most of the pentosans and much of the pectins pass into the final molasses. Their presence in molasses somewhat inhibits crystallization, but apparently not so much as the so-called " melassigenic " inorganic salts, such as alkali-chlorides, to which are nowadays ascribed the chief power of preventing sucrose crystallization. Chlorophyll is present in suspension especially in cane juice from unripe canes. It is usually easily eliminated. Anthocyan pigments, which occur in significant amount only in the juices from red and purple-rinded canes, exhibit characteristic colour changes as the reaction of the juice is altered by liming. In acid juices, the colour is pink ; in alkaline juices, it is dirty blue-green. Excess of lime appears to effect some pre-

[1] See HARDY ; *I.S.J.*, 1926, 494.

cipitation of anthocyan pigments; adsorbent chars, even in acid media, completely remove them, but sulphur dioxide does not perceptibly bleach them. Traces of ferric salts, such as may gain access to cane juice from iron mill-rollers or other factory machinery, react with anthocyans to yield brown coloured products akin to iron-tannin compounds. The tannin of cane juice is derived mainly from cane-tops and stem-buds or "eyes." It possesses the chief properties of catechol, or iron-greening tannins. Although not itself a true colouring matter, cane-tannin reacts with traces of ferric salts to form an intensely coloured substance difficult to remove from cane juices, but amenable to bleaching by sulphur dioxide, and to complete removal by adsorbent chars. Saccharetin is an ill-defined pigment that appears to originate in the lignin component of cane-fibre or bagacillo from which it appears to be most readily split by hydrolysis in alkaline media. It may be the same as, or similar to, the yellow or rich-brown pigments that arise when almost any carbohydrate is treated with an alkali such as lime. It is similar to tannins in many of its reactions, forming deep sepia-brown compounds with ferric salts, and pale-coloured compounds when reduced by sulphur dioxide. It is only through a full knowledge of the nature of the properties and relationships of these various compounds, that satisfactory control of the processes of sugar manufacture can be attained, and the value of suggested new procedures accurately assessed.

ON THE ELECTRICAL DETERMINATION OF ASH. **K. Sandera.** *Zeitsch. Zuckerind. Czecho-Slov.*, 1927, **51**, *No.* 49, 603-612. In a previous article an apparatus for determining the electrical conductivity of sugar solutions, using optical indication for the balancing of resistances, instead of the usual telephonic methods, was described.[1] This apparatus is now on the market in a suitable case, directions for its operation being here given. It is not right to judge the conductimetric method on the fact of its giving results agreeing with gravimetric figures. It really gives a different idea of the non-sugar content, based on its inorganic anions or strong organic acid anions, as the case may be, and these data may be of more value than the mere "ash" determination as found by incineration.—MICROSCOPY OF SUGAR CRYSTALS. **P. Honig.** *Archief*, 1927, **35**, *II*, *No.* 27, 693-697. Much useful information can be obtained by the microscopical examination of sugar crystals, and among observations made are the following: When water is used for dissolving up false grain, the large crystals are injured, being etched; steam used as covering medium in the centrifugal also affects the surface, the more so the higher the temperature, but covering with saturated syrup (as in refining) has least effect. Syrups before crystallization may be cloudy, but bright after crystallization, which difference is seen under the microscope to be due to the inclusion of the insoluble matter in the interstices of the growing crystals. These points are illustrated by 15 micro-photographs. —TESTS WITH SWEETLAND AND KROOG PRESSES. **T. van der Linden.** *Archief* (*Verslagen, afl. No.* 4), 1927, 101-108. Using syrup containing sulphite scums (from the Bach white sugar process), two Sweetland presses having a total filtering area of 130 sq. metres did the same work as six Kroog's having 288 sq. metres capacity; the Sweetlands required less water for sweetening off down to a certain sugar content. Less labour also, but the scums had to be detached with water, steam being insufficient. From tests made with sulphitation juice, it was calculated that per 25,000 piculs (1535 long tons) of cane, 3 would just suffice, 5 being really necessary.—CLEANING THE EVAPORATOR. **Ch. H. Nielsen.** *Archief* (*Verslagen, afl. No.* 4), 1927, 108-117. Instead of scraping off scale every few weeks, it is more economical in time to stop every few days (12 hours at a time), as the scale is then softer and more readily removed, the hours of stoppage thus being reducible from about 352 (in 1924) to 261 (last season). In the discussion R. F. H. SCHMIDT said "Sugar House Alkali" had given good results, and G. BENTHEM confirmed this.—*pH* VALUES FOR INVERSION. **Emile Saillard.** *Suppl. hebd., Nos.* 1995, 1998, and *No.* 2000. Following are the *pH* values at which at 100° C. inversion is incipient; factory molasses, 4·92; second massecuites, 5·52; and second sugars. 5·50. Inversion at 100° C. requires a higher *pH* than at 80° C., but the difference is not great. These values relate to beet products only.

J. P. O.

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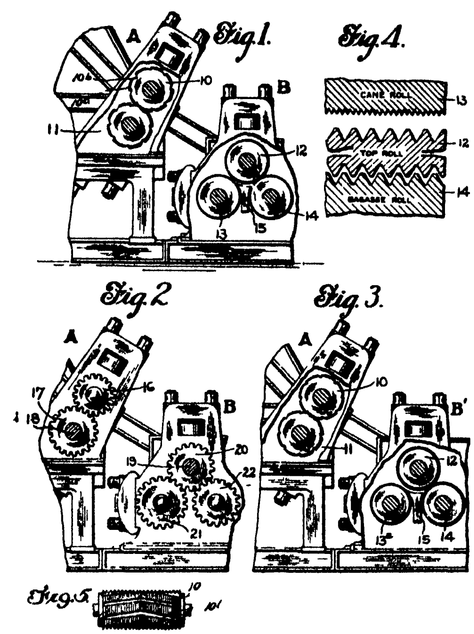
[1] *I.S.J.*, 1927, 280.

Review of Recent Patents.[1]

UNITED STATES.

Cane Mill Installation having Surface-Speed Differences between Grooved Intermeshing Rolls. Franklin Farrel, Jr. (assignor to **Farrel Foundry and Machine Co.**, of Ansonia, Connecticut, U.S A). 1,635,263. July 12th, 1927.

In the mill shown in Fig. 1 is a preliminary crusher *A*, in front of a juice expressing mill *B*, the crusher comprising a pair of toothed rolls 10, mounted in a stand or housing 11. There may be two or more crushing rolls, but in the embodiment under discussion the cane from the field is delivered to the pair of rolls 10 by a suitable conveyor and chute (not shown), the stalks then pass directly to the mill *B*, consisting of rolls 12, 13 and 14 which crush and express a portion of the juice from the cane, the mill *B* being followed by a plurality of similar mills. The crushing rolls 10 preferably will be provided with annular grooves, and with longitudinal grooves forming, in connexion with the annular grooves, teeth for hooking or drawing in the cane so that the latter will be fed into the machine uniformly and expeditiously. A suitable roll for the purpose is shown in Fig. 5. It has a plurality of circumferential grooves 10^a and a plurality of generally longitudinal grooves 10^b. The circumferential grooves of each crusher roll mesh with those of the other roll, and the grooves 10^b form interruptions in the circumferential grooves and create teeth that are adapted to draw in the cane. With the purpose of increasing the shredding effect of the rolls, both of the preliminary crusher, and three-roll mill, and of augmenting the capacity of the machine, a differential motion of one roll relatively to its co-acting roll is provided. One roll rotates at a materially greater surface speed than the roll on the opposite side of the cane stalk. The result is the stalks are torn apart more thoroughly and more effectively shredded and opened up, separating the individual fibres of the cane to a considerable degree. By shredding the cane in this manner the fibres are put in a condition in which they will readily give their juice when they are subjected to



the increased squeezing action of the following rolls. The best results are obtained where the surface speed of one crushing roll is at least 5 per cent. greater than that of its co-acting roll. In Fig. 1, one of the crusher rolls has a surface speed substantially 10 per cent. greater than its mate, and one of the rolls of the mill *B* has a surface speed substantially 10 per cent. higher than that of a co-acting roll. In the particular form shown in Fig. 1, the top crusher roll has a surface speed substantially 10 per cent. greater than that of the lower crusher roll, and the top roll 12 has a surface speed substantially 10 per cent. greater than that of its co-acting lower roll 13. In this particular case also, the speed of roll 12 is the same as that

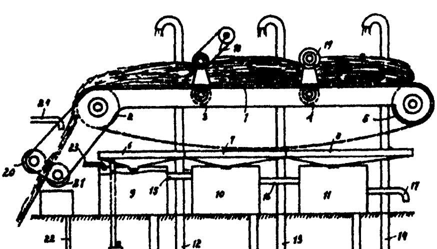
[1] Copies of specifications of patents with their drawings can be obtained on application to the following—*United Kingdom:* Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London. W.C. 2 (price 1s. each). Abstracts of United Kingdom patents marked in our Review with a star (*) are reproduced from the *Illustrated Official Journal* (*Patents*), with the permission of the Controller of H.M. Stationery Office, London. Sometimes only the drawing or drawings are so reproduced. *United States:* Commissioner of Patents, Washington. D C. (price 10 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille, du Temple, Paris. *Germany:* Patentamt, Berlin, Germany.

of bagasse roll 14. It will be seen therefore that in the three-roll mill, as in the crusher, circumferentially grooved intermeshing upper and lower rolls have surface speeds which differ substantially from each other. Changes may be made in the details however, without departure from the principles involved. In the case under discussion the two co-acting crusher rolls 10 are of substantially the same diameter; and the three rolls of mill *B* are all of substantially the same diameter, which diameter will in practice be preferably but not necessarily slightly greater than the diameter of rolls 10. The differential motion may be obtained by intermeshing gears on the roll shafts, having a dissimilar number of teeth. The gear 16, by which the upper roll 10 is driven, has a somewhat smaller number of teeth than its co-acting gear 17, the difference in the number of teeth being so chosen as to bring about the relative roll speeds desired, the difference in this particular case being substantially 10 per cent., as above stated. The lower roll 10 is driven by a shaft 18 on which gear 17 is mounted, the gear 16 being mounted on the shaft of the upper roll 10. The mill *B* is driven from a shaft 19 connected with or carrying the rooll 12, and a gear 20 on said shaft meshes with a gear 21 on the shaft of cane roll 13 and with a gear 22 on the shaft of bagasse roll 14. In this particular case, the gear 21 has a larger number of teeth than the gears 20 and 22, such number being so chosen as to effect the drive of the top roll at a surface speed which is 10 per cent. higher than that of the cane roll 13. The grooving of the rolls 20, 21 and 22 is shown in Fig. 4. In the modified form shown in Fig. 3, the preliminary crusher *A* is the same as that previously described, but in the three-roll mill B^1, the cane roll 13 , instead of being of substantially the same diameter as the other rolls of mill B^1 is of somewhat smaller diameter. It has, however, the same number of revs. per min., owing to the fact that in this case gears (not shown) having an even number of teeth are mounted on the shafts of rolls 12, 13^a and intermesh, in accordance with the usual practice, in which manner the relative surface speed of the cane roll is decreased. In such a mill, also, the surface speed of the top roll is at least 5 per cent. greater than that of the cane roll and in this particular case the top roll surface speed is about 10 per cent. faster than the cane roll surface speed, as in the case previously described. In the mill *B* or B^1, on the other hand, the top roll has a greater surface speed and while the stalks are held by the cane roll the top roll ribs tear them apart and shred them. In this particular case the cane roll grooves are smaller than those of the top roll, as shown in Fig. 4, and the roll with the small grooves is the slower one. As a general rule the crusher rolls are provided with teeth, and the ribs of the upper and lower crusher roll are of the same pitch, corresponding somewhat to the top roll and bagasse roll of the three-roll mill, although usually the pitch is greater than in the case of these particular rolls of the three-roll mill. The cane roll is set farther apart from the top roll than is the bagasse roll, although the distance between the top roll and cane roll is usually somewhat less than the distance between the two crusher rolls 10. As the top roll and bagasse roll are set quite close together, they can exert a powerful squeezing action on the cane, and as the cane has been effectively shredded in the crusher and in the bite of the top roll and cane roll, the squeezing action in the close bite of the top roll and bagasse roll of the three-roll mill is very effective in extracting juice. It is preferred to increase the surface speed of the top roll relatively to that of the cane roll, in the three-roll mill, on account of the tendency of the faster roll, i.e., top roll, to carry along the cane in the same general direction as the curvature of the upper surface of the turn plate, which thus cleans off the latter and prevents clogging. By providing a friction motion on the cane between the top roll and cane roll, the cane is better conditioned, by the resulting shredding effect for the subsequent heavy squeezing action, produced by the top roll in combination with the closely set bagasse roll. It may be advantageous in cases, to differentiate the surface speeds of the top roll and bagasse roll, respectively, for producing a shredding action which will be of value in the following mill; and in such cases, whether the top roll or the bagasse roll may be the faster one. This surface speed difference, also, may be effected by dissimilar toothing of the gears or by difference in the roll diameters, as in the cases previously mentioned. Usually the pressure between the top and bagasse rolls of the three-roll mill is greater than that between the rolls of the preliminary

crusher. The pressure in the preliminary crusher may be, say, 250 tons, whereas that in the first three-roll mill may be, say, 375 tons. The inventor is aware that in prior three-roll mills, and possibly in preliminary crushers, there have been surface-speed differences between circumferentially grooved intermeshing rolls caused by the uneven wearing of the roll surfaces, in certain instances, and in some few cases there have perhaps been differences of surface speed resulting from inaccuracy in manufacture or similar causes. In such cases, however, so far as he is advised, the surface speed difference between co-acting rolls has not amounted to say, more than 1 or 2 per cent., usually less, and it has been produced unintentionally and not by dissimilar gear toothing or for the purpose of producing the slightly increased shredding effect which may be incidentally caused thereby. Usually it is more convenient to have the two co-acting crusher rolls of the same diameter and drive them by gear having a dissimilar number of teeth as described, but it is obvious that in some cases the difference of surface speed might be obtained by differences of diameter of the crusher rolls, as explained in connexion with the top and cane rolls of the three-roll mill of Fig. 3. Other changes in this and similar respects may be made without departing from the scope of the invention as defined in the claims.

MACERATION OF BAGASSE (BEET SLICES, ETC.). **Nicolaas Nobel**, of Pasoeroean, Java. 1,617,962. February 15th, 1927.

The invention comprises maintaining an abundant liquid flow passing from above to below through a thick mass of the sugar-containing material, this mass being moved horizontally and the liquid dripped through, at least the greater part of it being used again and again. Bagasse, e.g., is conveyed by a plank-carrier in a thick blanket, about 75-100 cm. (29-39½ in.) thick instead of the usual 20 cm. (8 in.), from one mill to the next with a velocity of ½-1 metre per minute. A short distance between the mills is sufficient for the applying of this process and also a relatively small quantity of liquid, as same is repeatedly used. In most factories in Java, the distance between the adjacent mills is too short for applying the known process. The liquid is poured upon the material at different places and the liquid dripping through is received by separate receptacles, whilst each receptacle is filled up by the liquid from the adjacent receptacle at the end side of the conveying path (the last receptacle being filled up by fresh liquid) and decreased by conveying a part of it to the adjacent receptacle at the other side (the contents of the first receptacle being decreased for macerating at a previous interval between the mills or for being added to the juice for further treatment or treated separately for sugar-extracting purposes). Due to the movement of the material the liquid contained therein is also conveyed to above the next receptacle. Therefore the counter-current action may be improved by applying means for expressing the material preferably a little distance before the place situated above the walls separating the receptacles. In the drawing an apparatus according to the invention is shown by way of an example. The endless belt 1 to a plank carrier is supported by rollers 2, 3, 4 and 5. Under this carrier three hoppers 6, 7 and 8 are provided above receptacles 9, 10 and 11. Through conduits 12, 13 and 14 the macerating liquid is pumped from these receptacles to points above the mass of the sugar-containing material, conveyed by the carrier and allowed to drip down upon such material. The receptacles are connected to each other by open overflow conduits 15 and 16 respectively and the receptacle 11 is provided with an open overflow 17. For expressing the material an endless belt 18 with its rollers and a drum 19 are provided some distance before the points rights above the separation lines between the hoppers. Before entering next mill, the material is expressed between rollers 20 and 21, the expressed liquid being conveyed through a conduit 22 to the receptacle 9, in which some of the macerating liquid, preferably fresh, is



supplied through a pipe 23. Before the rollers 20—21 macerating liquid of fresh water may be supplied through a pipe 24. The capacity of the pumps pressing the liquid through the conduits 12, 13 and 14 is such that e.g. each pump conveys 50 litres per sec., the conduits being e.g. of 8 in. diameter. The overflow 17 is lower than the overflow 16, which is lower than the overflow 15. A heating of the liquid may be applied, e.g. by introducing steam into the conduits 12, 13 and 14.

PRODUCTION OF POWDERED SUGAR CANE FOR FOOD. **Albert E. Kienzle,** of Cairo, Egypt. 1,633,895. June 28th, 1927.

Sugar cane is cut into chips or discs of preferably 2-5 mm. thickness and dried and ground, the flour so obtained owing to its considerable sugar content being used directly as an article of human and cattle food. If used for human nourishment, the flour may form a component of products such as ginger-breads, biscuits, cakes and sweetmeats generally; and may also be used as an addition to cocoa, chocolate, artificial honey, fruits, jams, juices, syrups, and a variety of beverages and liquors such as lemonade, beer, wine, rum and liqueur. A further field of use of the flour is in distilling. If the chips are dried at a low temperature, a pure white or slightly yellow product is obtained, and the flour made therefrom has a honeylike taste and smell. If dried at a higher temperature, they become brown, and the flour made therefrom has the flavour and smell of malt. If dried at a still higher temperature, they become dark brown and the flour thereof may be used in the manufacture of black-beers, and other products having a caramelized sugar content. By further raising the drying temperature, a still more extensive conversion of the sugar is effected and the resulting product is not sweet but resembles roasted coffee with respect to its smell and taste and colouring quality. It is possible to divide up the cane into a portion rich and a portion poor in sugar. This can be done either by separating the rind and nodes from the remainder and subjecting the several portions to separate treatment or by suitably conducting the grinding process. The former being much harder than the pith are more resistant to pulverization and the coarser particles formed therefrom during grinding can be separated to a certain extent from the finer particles of the pith by sifting. Flour obtained by grinding chips or discs may be divided by sifting into four grades; the coarsest about 15 per cent, nearly free from sugar, mainly consisting of the product of the rind and nodes, may be used as fuel or in cattle food. Sugar contents of the three further grades are as follows:—25-60 per cent. the coarse grade; 40-70 per cent. the middle fineness; 50-80 per cent. for the finest grade. The finest and sweetest grade flour is particularly well adapted for use in the manufacture of confectionery as the sole sweetening agent or in combination with sugar. The medium product is used for preparing sweet liquors; and the coarsest in the production of alcohol. The following table shows the analysis of the finest and coarsest of three grades of flour

	Finest grade.	Coarsest grade.
Fibre	8·71	15·68
Sugar	70·94	58·97
Other extractive matter free from nitrogen	16·88	21·35
Crude protein	1·63	1·62
Ash	1·84	2·38

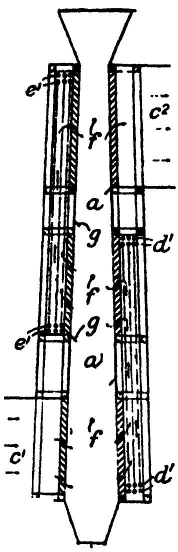
from Otaheite cane with about 15 per cent. of sugar. In cutting the cane into chips or discs it is advisable to make the cuts inclined to the direction of the axis of the cane so as to produce discs of extended area in order to facilitate the drying and the grinding operations. Flour produced as above described is liable to decompose in moist climates. In order to avoid this difficulty, and to make a product adapted for exportation, it may be subjected to briquetting. In order to further assist the preserving effect of the briquetting operation the briquettes may be packed into air-tight containers or they may be impregnated with preserving liquids or covered with a protecting layer such as a pure sugar coating. The form and size of the briquettes being immaterial, it is also possible to tightly pack the flour in portable receptacles such as sheet metal barrels so that the contents of a barrel as a whole forms one single briquette.

DEXTROSE MFRE. **Wm. B. Newkirk** (assignor to **International Patents Development Co.**, of Wilmington, Del., U.S.A.). 1,640,717. August 30th, 1927. A method of making large grained crystalline dextrose from a starch-converted solution consists in maintaining a relatively large quantity of dextrose crystals uniformly dispersed through a solution and gradually cooling the solution to maintain a supersaturation so slight that most of the dextrose crystallizing out of the solution goes to build up the size of the crystals originally introduced.—CANE CAR. **Robt. J. Magor**) (assignor to the **Magor Car Corporation**, of Delaware, U.S.A.). 1,640,785. August 30th, 1927. In a partitionless cane car, the combination is claimed of an underframe including a side sill, and a cross bearer, of a belt rail extending parallel to the side sill and positioned above the same, a plurality of side gates hinged at their upper edges to said belt rail and normally depending therefrom and abutting the side sill, two locking rods journalled to the side sill and coacting to constitute all the means for locking the gates in position engaging the side sill, a partition post between adjacent doors and connecting the side sill and belt rail, and buttress brace in rear of the partition post secured thereto and operatively disposed to brace the partition post and belt rail and to transmit strains thereon downwardly and inwardly to the cross bearer.—PRODUCTION OF GLUCOSE FROM MATERIALS CONTAINING CELLULOSE. **Ludolf Meiler and Heinrich Scholler**, of Munich, Germany. 1,641,771. September 6th, 1927. The process is claimed of producing glucose from cellulose-containing material which comprises treating the material with a mineral acid, treating the resulting mixture to the influence of mineral acid gas under pressure, diluting the resulting mixture without precipitation, separating the undissolved materials from the soluble ones, diluting the solution causing a precipitation, separating the precipitated materials from the solution, treating the precipitated materials to form glucose and separating the glucose from the solution.—YEAST PROPAGATION FROM MOLASSES CANE. **Arnold K. Balls**, of Philadelphia, Pa., U.S.A. 1,642,192. September 13th, 1927. Claim is made for the method of growing yeast which comprises adding a yeast stock of *Saccharomyces disjunctus* to a mash of crude West Indian cane molasses and allowing the yeast to propagate therein.—CONTINUOUS CENTRIFUGAL MACHINE. **Hans C. Behr**, of Scarsdale, N.Y., U.S.A. 1,642,662. September 13th, 1927. In a device of the character described, the combination of a rotary fluid distributing member, a foraminous separating member surrounding the periphery of the same and a receiving member outside said foraminous separating member, the said foraminous separating member being mounted to rotate at a different rate from the distributing member, and the receiving member mounted to rotate in phase therewith.—CENTRIFUGAL MACHINE FOR THE MANUFACTURE OF PILÉ SUGAR. **Ricardo Lehky**, of Buenos Aires, Argentina. 1,628,321. May 10th, 1927. In centrifuging pilé sugar there is at present a difficulty and a considerable loss of time involved in having to loosen the moulds which divide up the lumps of sugar in order that they may be taken out easily. Even after the removal of the mould, the lumps of sugar generally remain adhering to the sides of the drum. To overcome this difficulty, the inventor superposes a ring, which, by means of a special mechanism is lifted at will on completion of centrifuging, thus loosening the lumps of sugar and the moulds interposed between them.—CANE HARVESTER. **Henry O. Scranton**, of Jeanerette, La., U.S.A. 1,630,097. May 24th, 1927. This is an improvement on a previous filing,[1] and consists principally in certain modifications to the cutting mechanism, the claim now being for the following combination : In a harvester, a supporting frame, a vertical shaft journaled in the frame and provided with a cutter, a pivoted lever for raising and lowering the cutter, a toothed segment pivoted to the frame and provided with a rearwardly projecting arm, means for connecting the said arm with the pivoted lever, an operating lever connected to the said segment and projecting forwardly of it, and a spring-controlled catch lever pivoted to the frame and provided with a tooth which normally engages with the said segment, the free end portions of the said levers being arranged conveniently adjacent to each other.

[1] *I.S.J.*, 1925, 117.

UNITED KINGDOM.

DRYING APPARATUS. **Maschinenfabrik Grevenbroich,** of Grevenbroich, Germany. 275,239. July 27th, 1927; convention date, July 27th, 1926. Material is dried in the space between a casing and a rotary perforated air or gas distributing-drum, the space between being divided by partitions into zones which communicate through openings controlled by dampers with an exhaust duct. The drum is provided with agitating vanes, and the dampers are controllable from without the casing.—FILTER HAVING SHEET FILTERING MATERIALS. **E. J. Sweetland,** of Hazleton, Penns., U.S.A. 275,333. A filter for concentrating liquids is adapted to operate in cycles of three periods, a filtering period, a cleaning period and a period of rest during which the cake dislodged from the filtering elements is allowed to settle out of the filtering zone.—DRYING SUGAR BEET. **B. J. Owen,** of the Institute of Agricultural Engineering, Oxford University. 275,760. June 21st, 1926. Apparatus for drying beet cossettes, etc. consists of a vertical shaft *a* through which the material passes either continuously or intermittently while subjected to transverse currents of heated air which pass over heating tubes d^1, e^1 from an inlet c^1 to an outlet c^2, the sides of the shaft being inclined so that the time taken by the material in passing through the uppermost section of the shaft is substantially the same as that taken to saturate the air passing through the section. Bars *f* and ridges *g* are provided to retard the passage of the material through the centre of the shaft and to effect a thorough mixing of the material respectively. Several shafts may be disposed side by side and supplied with air from ducts arranged between them.—ROTARY FILTERS. **E. J. Sweetland,** of Hazleton, Penns., U.S.A. 275,779. July 23rd, 1926. Filter discs are carried by a rotatable horizontal shaft mounted in one part of a two-part casing, means being provided for moving the parts relatively to one another axially of the shaft in order to open the casing.—AMMONIUM PHOSPHATE AND AMMONIUM SULPHATE FERTILIZER. **F. Liljenroth,** of Stockholm. 275,843. November 26th, 1926; convention date, August 13th, 1926. Mineral phosphate is dissolved in sulphuric acid to form phosphoric acid and a precipitate of calcium sulphate. The phosphoric acid is separated, and the calcium sulphate, as a silt in water, is treated with ammonia and carbon dioxide to yield a precipitate of calcium carbonate and a solution of ammonium sulphate. The phosphoric acid is neutralized with ammonia and mixed with the solution of ammonium sulphate and the mixed solutions are evaporated to yield a manure consisting of ammonium phosphate and ammonium sulphate. The carbon dioxide used may be recovered by calcining the calcium carbonate or by treating it with nitric or other suitable acid.—CURING AND FINISHING SUGAR. **Raffinerie Tirlemontoise Soc. Anon.,** of Tirlemont, Belgium. (*A*) 276,527. November 2nd, 1926. (*B*) 276,611. November 22nd, 1926; convention date, August 26th, 1926. (*A*) Fine grain is removed from syrups or molasses by employing the surface action of particles of materials such as kieselguhr, paper, sugar crystals, etc., together with high centrifugal force. The materials may be mixed with the syrup, etc. before the centrifugal treatment, or may be inserted in the centrifuge so as to form a layer through which the syrup must pass during the treatment. (*B*) Raw sugar, after-product sugar, and the like are, prior to further treatment in the refinery, placed in store rooms the temperature and humidity of which are controlled by supervision or automatically so that the syrup surrounding the crystals attains and maintains as low a purity as possible, e.g. 60 per cent. or less of sugar in the total dry content of the syrup. The crystals may subsequently be treated in centrifuges of high centrifugal force so as to remove entirely or almost entirely the syrup which is of so low a purity that it can be put aside as molasses without further treatment. If the crystals are subsequently subjected to further refining, a syrup of higher purity may be used in the treatment and less water employed in the subsequent washing.



OWEN'S OVEN.

Sugar Crops of the World.

(Willett & Gray's Estimates to November 23rd, 1927.)

	Harvesting Period.	1927-28. Tons.	1926-27. Tons.	1925-26. Tons.
United States—Louisiana	Oct.-Jan.	65,000	42,112	124,447
Texas	,, ,,	—	—	—
Porto Rico	Jan.-June	565,000	562,679	541,485
Hawaiian Islands	Nov.-June	729,000	724,403	705,360
West Indies—Virgin Islands	Jan.-June	8,000	7,077	6,664
Cuba	Dec.-June	4,000,000	4,508,521	4,884,658
British West Indies—Trinidad	Jan.-June	57,000	52,204	73,561
Barbados	,, ,,	59,000	58,685	47,535
Jamaica	,, ,,	60,000	65,280	57,675
Antigua	Feb.-July	18,000	23,501	12,800
St. Kitts	Feb.-Aug.	17,000	18,068	16,380
Other British West Indies	Jan.-June	6,000	4,969	7,550
French West Indies—Martinique	Jan.-July	45,000	45,039	48,121
Guadeloupe	,, ,,	31,000	35,673	32,998
San Domingo	Jan.-June	300,000	303,524	354,720
Haiti	Dec.-June	11,500	12,563	10,044
Mexico	,, ,,	175,000	181,858	190,282
Central America—Guatemala	Jan.-June	30,000	33,000	25,151
Other Central America	,, ,,	65,000	78,740	62,500
South America—				
Demerara	Oct.-Dec. and May-June	100,000	95,000	107,580
Surinam	Oct. Jan.	13,500	13,227	12,472
Venezuela	Oct.-June	23,500	19,000	21,321
Ecuador	Oct.-Feb.	23,000	20,321	16,976
Peru	Jan.-Dec.	290,000	275,000	282,857
Argentina	May-Nov.	350,000	475,695	395,733
Brazil	Oct.-Sept.	650,000	850,565	676,524
Total in America		7,691,500	8,506,704	8,714,384
Asia—British India	Dec.-May	3,200,000	3,208,000	2,977,000
Java	May-Nov.	2,350,000	1,959,948	2,278,900
Formosa and Japan	Nov.-June	600,000	499,425	616,584
Philippine Islands	,, ,,	600,000	584,238	436,705
Total in Asia		6,750,000	6,251,611	6,309,189
Australia	June-Nov.	485,000	415,611	522,344
Fiji Islands	,, ,,	95,000	85,000	70,567
Total in Australia and Polynesia		580,000	500,611	592,911
Africa—Egypt	Jan.-June	88,000	90,000	94,286
Mauritius	Aug.-Jan.	215,000	192,590	241,220
Réunion	,, ,,	56.000	56,579	59,015
Natal	May-Oct.	241,500	216,305	214,152
Mozambique	,, ,,	70,000	80,000	59,841
Total in Africa		670,500	635,474	668,514
Europe—Spain	Dec.-June	9,000	6,719	8,704
Total cane sugar crops		15,701,000	15,901,119	16,293,702
Europe—Beet sugar crops		8,205,000	6,860,252	7,453,293
United States—Beet sugar crop	July-Jan.	900,000	801,246	804,439
Canada—Beet sugar crop	Oct.-Dec.	30,000	28,250	32,475
Total beet sugar crops		9,135,300	7,689,748	8,290,207
Grand total Cane and Beet Sugar ... Tons		24,836,000	23,590,867	24,583,909
Estimated decrease in the world's production ,,		1,245,133	*993,042	862,689

* Decrease.

United States.

(Willett & Gray.)

(Tons of 2,240 lbs.)	1927. Tons.		1926. Tons
Total Receipts, January 1st to Nov. 23rd	2,829,380	..	3,156,522
Deliveries „ „	2,819,863	..	3,019,069
Melting by Refiners „ „	2,774,598	..	2,985,000
Exports of Refined „ „	100,000	..	79,000
Importers' Stocks, Nov. 23rd	124.380	..	146,109
Total Stocks, Nov. 23rd	207,361	..	223,456
	1926.		1925.
Total Consumption for twelve months	5,671,335	..	5,510,060

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR,
1925, 1926, AND 1927.

(Tons of 2,240 lbs.)	1925. Tons		1926. Tons		1927 Tons
Exports	4,399,231	..	4,110,196	..	3,580,813
Stocks	460,709	..	390,989	..	531,142
	4,859,940	..	4,501,185	..	4,111,955
Local Consumption	120,000	..	130,000	..	126,000
Receipts at Ports to October 31st ..	4,979,940	..	4,631,185	..	4,237,955

Havana, October 31st, 1927. J. GUMA.—L. MEJER

Beet Crops of Europe.

(Willett & Gray's Estimates at November 23rd, 1927.)

	Harvesting Period.	1927-28. Tons.	1926-27. Tons.	1925-26. Tons.
Germany	Sept.-Jan.	1,700,000	1,657,088	1,595,545
Czecho-Slovakia	Sept.-Jan.	1,300,000	1,043,259	1,497,004
Austria	Sept.-Jan.	105,000	79,498	78,145
Hungary	Sept.-Jan.	165,000	173,470	172,560
France	Sept.-Jan.	900,000	729,082	757,987
Belgium	Sept.-Jan.	300,000	233,421	332,170
Holland	Sept.-Jan.	260,000	287,427	306,083
Russia (Ukraine, etc.)	Sept.-Jan.	1,400,000	859,380	1,041,903
Poland	Sept.-Jan.	660,000	552,553	575,673
Sweden	Sept.-Dec.	145,000	20,871	204,500
Denmark	Sept.-Jan.	160,000	151,119	179,998
Italy	Aug.-Oct.	280,000	313,738	160,926
Spain	Sept.-Jan.	240,000	284,387	243,939
Switzerland	Sept.-Jan.	7,000	7,950	6,395
Bulgaria	Sept.-Jan.	35,000	31,485	38,309
Roumania	Sept.-Jan.	165,000	162,821	115,907
Gt. Britain and Ireland	Sept.-Jan.	269,000	165,465	51,784
Other Countries	Sept.-Jan.	114,000	107,238	94,465
Total in Europe		8,205,000	6,860,252	7,453,293

United Kingdom Monthly Sugar Report.

Our last report was dated 10th November, 1927.

Business on the London market has been much more active, during the past few weeks. Prices have been on the firm side during the whole period.

The Terminal Market has been chiefly concerned with the liquidation of the December account, and large quantities have been transferred to March, May and August. Owing to the various rumours caused by the visit of Colonel TARAFA to Europe, " bears " have been covered. A certain amount of speculative demand has been in evidence. Very little sugar was tendered on November, and this month finally finished at 14s. About 8000 tons was tendered on December 1st and caused the price to decline, but after the first few days, when these tenders were stopped, this month has recovered. December sold from 14s. 4½d. to 13s. 10½d. to 14s. 7½d., March sold from 16s. 3d. to 16s. to 16s. 9d., May from 16s. 6d. to 16s. 3d. to 17s. 1½d., and August from 16s 9d. to 16s. 6d. to 17s. 4½d.

There was a much better demand for actual sugar, and the trade, who were very short of stock, departed from their "hand to mouth" policy and bought five or six weeks' supply. There has been no pressure of Continental sugars, and the majority of the business was thrown on to Home Grown and British Refined. Ready Granulated sold from 15s. to 15s. 7½d., November/December from 14s. 6d. to 15s. 6d., January/March from 14s. 9d. to 15s. 10½d., April/June from 15s. to 16s. 3d. and March/August from 15s. 1½d. to 16s. 4½d. Spot sugar sold from 27s. 10½d. to 28s 3d., whilst old landed can be bought at 28s. German Granulated is still offering on the spot, but is not selling very readily. White Javas for May/June shipment have put their price up and not much business is passing. The Home Grown factories have continued to do a large business, and the price has increased from 28s. 3d. to 29s. The refiners have also done a large business, and on November 15th they raised their price 3d. per cwt., and also to-day, the 9th December, they have advanced their prices 3d. per cwt., their revised prices being No. 1 Cubes 32s. 3d., London Granulated 29s. 7½d.

Raws have been quiet and very little business passing. Small quantities of Brazils and Perus have been sold from 12s. to 12s. 4½d. c.i.f., and some San Domingoes for January shipment sold at 12s. 6d. No further sales have been made of Cubans by the Sugar Export Commission and it appears that no fresh sales will be made out of the old crop sugar. With regard to Cuba, no fresh announcement has been made with regard to the size of the next Cuban crop, but it is generally expected that the figure will be 4,000,000 tons. Colonel TARAFA has had various conferences in Paris, Amsterdam, Berlin and Brussels, and comes to London to-morrow before returning to Cuba. It is reported that he has come to arrangements with Germany, Czecho-Slovakia, Poland and Belgium who have all signed an agreement to co-operate with him in keeping a remunerative price for the sugar producer, but they do not appear to have agreed to restrict their crops.

Raws in America sold down to 2¾c., but the latest price is $2\frac{13}{16}$c., and a fair business was done at this price. There is little change to report in the Futures market.

With regard to Europe, F. O. LICHT has again made a slight alteration in his third estimate of the crop, which he now puts at 8,093,000 tons, being a reduction of 113,000 tons on his last estimate.

21, Mincing Lane,
London, E.C.3.,
December 9th, 1927.

ARTHUR B. HODGE,
Sugar Merchants and Brokers.

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GENERAL INDEX.

[(N.C.) implies *Note and Comment;* (Par.) *Paragraph;* (Corr.) *Correspondence;* (Abs) *Abstract;* (D. O. T. Report) *Department of Overseas Trade Report;* (Am. Comm. Report) *American Commerce Report.*]

NAMES.

PUBLICATIONS RECEIVED.

SUBJECT MATTER.

Publications Received

NAMES.

PATENTS.

SUBJECT MATTER.

NAMES.

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